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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Next Week's International Congress.

On Tuesday next the International Foundry Exhibition and World Congress opens in Paris. From the latest available information it does not appear that the British party will be as large as might have been anticipated under more favourable industrial conditions, but it will be representative, and that is a very important point. Few people when considering whether they can afford the expenditure of time or money involved in such a visit, or who weigh the pros and cons of whether this would in their particular case be justifiable, pause to reflect on the importance to a nation of adequate participation in international events of this character by their presence, their contributions to discussions, their attendances at committee meetings, and so on. The nationals of other countries get the idea that the industry in the home country must be alive and active, and this is all to the good.

The arrangements made for the reception of visitors and for their entertainment and instruction, appear to be of the most complete character, and we feel sure that the party will profit by the friendships that are established and renewed, and from the business discussions which will take place. We have heard it suggested that the prevailing political conditions are not such as to foster any international trade, and that any movement contributing towards this is running against the tide of economic nationalism, which is now running so strongly. This very fact, however, makes these international contacts of all the more importance, for while handicaps to international trade exist it becomes more and more important for any country to learn what others are doing and thinking. Invention, industrial development, and scientific discovery are not the monopoly of any one country.

At no time in its history has the foundry industry in this country been so well organised as it is at present, through representative bodies, technical, scientific, commercial and research, on both the manufacturing and supply sides, and where circumstances prevent a large gathering of individuals it is particularly useful to have representatives of these various bodies in attendance, so that the information gleaned can be passed on to the industry through the organisations with which they are connected.

An Interesting Development.

Elsewhere in this issue we describe in considerable detail a development in moulding practice currently used in the south-east of France. The new process relates to the use of an underhydrated sand-cement mixture as a mould material capable of receiving any liquid metal, including mild steel. The cardinal point as revealed by the article is the control of porosity by keeping the moisture content between 7 and 10 per cent. The great drawback to the process, however, is the loss of time through the necessity for air-drying the moulds. Just how far this would operate disadvantageously in Newcastle or Manchester it is difficult to estimate. After all, in the region between the Alps and Marseilles, for days on end, the mist only lifts between 11 and 4. Still, as the process is in its infancy, methods of accelerated air-drying may be discovered. As the author points out, the turnover per unit floor space not being high, the process is ruled out for quantity production. The elimination of box-parts, and drying stoves, associated with the reclamation and re-use of the material, appear attractive. When rumours of the process first reached England it was said that permanent moulds were being made, but all statements of this character should be received *cum grano salis*, as reference to the complication inherent in the die casting of quite small articles quickly reveals. The author touches upon this question when he points out that where intense pulls are encountered, a thin shell of sand-cement backed with loosely-rammed sand is utilised for taking care of it. One of the most interesting features of the process is the extension of the principals of reinforced concrete construction to moulding practice, so as to eliminate the need for moulding boxes. After all, moulding boxes are expensive entities when they merely act as a reinforcement to be used on odd occasions and to occupy floor space for the remainder of their life. We shall not fail to be present when this subject is discussed in Paris next week, as the process has every appearance of finding a distinct niche in the foundry practice of the future.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Vee Belts.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have just read THE FOUNDRY TRADE JOURNAL of Thursday last, and note the remark on my paragraph on vee belts. There are many kinds of vee belts on the market, many of these being made of materials similar to ordinary belting. On these it is permissible to use the usual belt dressings, castor oil being often used. My paragraph was written in view of the smaller vee belts such as are used for machine drives, etc. Some of these are made so that they do not require dressing, but on others a dressing is advisable.

Your correspondent deals with a type of belt of which I have had no experience, but assuming that castor oil or similar dressings would be harmful, I think that instructions as to the treatment of the drive would be supplied with it, so the risk caused by my paragraph as regards belt dressing is, in my opinion, negligible. Your correspondent evidently wrote dealing with one type of belt only, whereas there are a great many on the market.—Yours, etc.,

THE AUTHOR.

September 5, 1932.

Book Review.

Betrebsbuchhaltung und Kostenrechnung in der Eisen und Stahlgiesserei (Bookkeeping and Cost Accounting in Iron and Steel Foundries). By A. GEISSEL. Published by the Verlag Wilhelm Knapp in Halle-Saale, Germany. Price (bound) 11.50 R.M. and (unbound) 10 R.M.

This book is Vol. 17 of a series of works on "Iron, Steel and Non-ferrous Foundry Practice," edited by Hubert Hermanns. It is extremely thorough in lay-out and covers completely the ground of costing as applied to foundry practice. It is divided into four main sections:—Underlying principles; construction of a system; accountancy and the presentation of statistics. The question of entering up the receipt of an order is thoroughly dealt with and the form evolved necessitates about 30 entries. This sounds much more formidable than is really the case. Actually they are: Agent; reference; firm; town; street; order number, per card, letter or telegram (two to be crossed out) of; (date); received; started; delivery address, per rail or lorry (one to be crossed out); price; delivery date; discount; patterns; number of types; number of castings; description; pattern number; drawing number; weight of individual casting; total weight; material and classification reference; remarks; inspection date; report; inspector's name; despatched weight, by whom. We expect that Germans, like the British, start out with a very complete card and fill up just as much as experience has shown desirable. We were very interested in the bibliography, as it shows the very serious attention devoted to this subject of costing in Germany. As is usual, the only expert recognised in England is Mr. A. W. G. Bagshawe, whose work is invariably labelled as being American, and whose name now has to suffer mutilation. We hope that in reproducing German names we do not exhibit such carelessness as is evident in the foundry technical literature of that country. We do hope that as many people as possible will buy this book, study it and contribute their criticisms to the appropriate Committee of the Institute of British Foundrymen. At the moment, British literature on costing is characterised by the smallness of its quantity and the excellence of its quality. A proper study of costing, such as is detailed in this excellent little handbook, by the mass of the personnel of the British foundry industry would do more to raise price levels than any other effort conceivable.

District Presidents.—No. 4.

FALKIRK SECTION OF THE SCOTTISH BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN.

Mr. Thomas Shanks, the newly-elected President of the Falkirk section of the Scottish Branch of the Institute of British Foundrymen, received his elementary education at the Denny School and afterwards at Allen Glens School, Glasgow, where he particularly followed a chemical course. He started work in the foundry of Messrs. Cruikshanks & Company, Limited, Denny, afterwards entering a pattern shop on the Clyde where he worked for 18 months before entering the machine and fitting shops of a well-known firm of engineers and pump makers near Glasgow, and also spent another 18 months and then a year in the drawing office of the same firm. During the 5½ years that he worked in Glasgow Mr. Shanks attended the

MR. THOMAS SHANKS

(Chairman of the Falkirk Section of the Scottish Branch of the Institute of British Foundrymen).

metallurgical course at the Royal Technical College.

At the end of 1925 Mr. Shanks returned to Denny and became assistant works manager to Messrs. Cruickshanks & Company, Limited, Denny Ironworks, where he has remained until the present time and now occupies the position of Works Manager and Junior Director. Mr. Shanks became a life member of the Institute of British Foundrymen in 1929 and has served on the council of the Scottish Branch for two years.

Potential Markets in Switzerland.—The recent fall in the exchange value of the pound sterling has altered the price factor, and the Swiss market, if properly handled, should now prove a good outlet for British metals and semi-manufactured goods which Switzerland's industries are obliged to import. Its machine and metal industry has to rely almost exclusively on foreign sources of supply for raw materials, *e.g.*, iron, steel and other metals (except aluminium), coal, foundry coke, etc. The same may be said of semi-manufactured products such as special-shaped and unfabricated iron and steel, etc., although in this category local production, particularly in respect of castings, for example, meets the requirements of the industry to an appreciable extent; but machinery of special design and of exceptional dimensions is frequently obtained from abroad.

Random Shots.

If "Marksman" were but one of those pithy paragraph writers whose observations on the world at large lend grace to the columns of the daily Press, the diary for the coming week might be quite interesting and lucrative to the civil aviation industry. "Marksman" confesses that he has not the qualifications to assume such a rôle. You see, he has not the powers to attend two separate functions at the same hour on the same evening, as apparently have some of the more notorious columnists of the day. But he will do his best.

* * *

Monday.—Does the French nation ever take a meal in its own home? Only yesterday, at Lille, I assisted at a midday Sunday luncheon organised by the regional foundrymen's association, in honour of a party of foreign fellow-craftsmen who are now touring the locality. I had the signal honour of being placed next to Monsieur Pasdutout, whose foundry along the Seine is now busily engaged turning out hundreds of thousands of Nui-tuis. Do you know just what a Nui-tui is? Monsieur Pasdutout told me that lucky charms are the vogue in France at the moment, and a Nui-tui is no more than an ugly little pixy cast in aluminium. "Superstition," remarked my neighbour, "is a profitable thing to exploit. A Nui-tui costs a few sous to make, but sells at 15 francs. And if you believe in evil spirits, isn't it worth spending 15 francs to have a safeguard against them?" By the end of the evening I was the unwilling possessor of a half-dozen Nui-tuis.

* * *

Tuesday.—After crossing the Channel this morning, I happened to encounter Mr. Andrew Harley, the President of the Foundrymen's International Technical Committee, on his way to preside over his first meeting in Paris. The Scots and the French have always got along very amicably together, and Mr. Harley, who is a native of Falkirk, was looking forward very keenly to his visit. Unfortunately, the weather was against a long range of visibility; there was mist, and rain and rough water, all of which temporarily quenched my love of the sea.

* * *

Wednesday.—Last night I dropped into the Science Museum at South Kensington "to see what I could see." All the stars of the metallurgical firmament were gathered together in a brilliant assembly. Just what was the connection between medicine and metallurgy I could not quite decide, for every other guest seemed to be a doctor. I came across one (he was putting pennies in a case containing a model steam engine, and watching the wheels go round) who was pointed out to me as being a Ph.D.

What exactly is this Ph.D.? asked I, producing my Ralph Lynn expression.

"Oh! it's quite simple," he said. "You see, I am a Doctor of Photography. My job is to take all the photomicrographs used in these technical Papers on iron and steel. Lend me a penny, will you, please? I have no more coppers."

* * *

Etcetera. . . .

MARKSMAN.

New Companies.

Rea Metal Casements, Limited, Knowsley Works, Etna Street, Stanley, Liverpool.—Capital £2,000.

Die-Casting Appliance Corporation, Limited.—Capital £100. Secretary: H. A. Whiting, 69, Leadenhall Street, London, E.C.

Arcon Engineering Company, Limited, 26, Flanders Road, London, W.—Capital £1,000. Directors: A. W. Sharman and F. O. Read.

The "Sesci" Melting Furnace.

A PULVERISED-FUEL-FIRED ROTARY UNIT.

The production of sound castings is, of course, the first objective of every foundry manager, the necessity becoming the more imperative in accordance as the duties to which the castings will ultimately be put, become more exacting. In no section of the engineering industry are the working conditions more severe than with the heavy-oil internal-combustion engine. Cast iron forms the major portion of the basis of such engines and the metal must be made as suitable as possible for the varied requirements of the different parts.

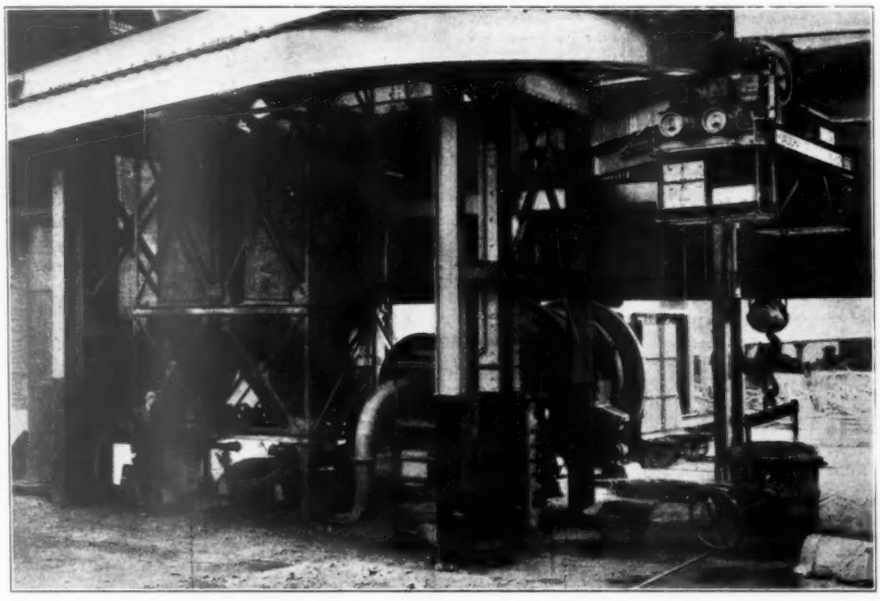

FIG. 1.—GENERAL VIEW OF "SESCI" FURNACE AND POWDERED FUEL HOPPERS. LADLE HOIST IS ALSO SHOWN.

The National Gas Engine Company, Limited, have always shown a very real appreciation of the foregoing, and within the limits of the methods available have kept their product of a consistently good quality. There has never been any cheese-paring policy in the foundry; just as improvements in method and apparatus have been perfected they have been adopted, though it may be said at the outset, production costs have always been subordinate to the quality of the output. It is not surprising, therefore, that this firm have a high reputation for the quality of their castings, a reputation of which they are justly proud.

Metal-melting is the first and most important problem in any foundry. As all foundrymen know, it is extremely difficult to keep cupola-melted cast iron under perfect control in regard to the chemical composition of the metal, the elimination of contamination by the fuel or the resultant gases, the degree of superheat, coupled with the difficulty of thoroughly mixing the constituents of the charge.

Following the introduction of the "Sesci" melting furnace and after a very thorough investigation of its possibilities, the National Gas Engine Company, Limited, have recently installed a 5-ton furnace of this type in their foundry. The first objective of the installation was the production of more uniform and higher-grade castings, which is made possible by the more perfect control of the melting operations. The results have already amply justified their enterprise. The castings produced are homogeneous and close-grained, with fewer metallurgical defects, such as gas holes, draw places, porosity, etc. The new method of melting obviates any risk of not getting quite the right quality of metal in the various castings made, and there is no doubt that as experience accumulates, it will be possible to improve very considerably the quality of cast iron.

The "Sesci" furnace embodies an entirely new system of melting. Instead of the continuous method of melting in the cupola, the metal is melted in batches, using pulverised anthracite as fuel. The furnace is of the rotary type. Of course, the principle of the rotary furnace is far from new, for we find that in 1869 Siemens applied for patents in Berlin for a rotary furnace fired with pulverised fuel for the melting of metals, and there have also been more recent rotary furnaces for metal melting, whilst the rotary furnace universally adopted in the cement works is very well known. It is, therefore, chiefly in the application of the pulverised fuel that the "Sesci" furnace varies from its predecessors; this, however, is the paramount matter for consideration.

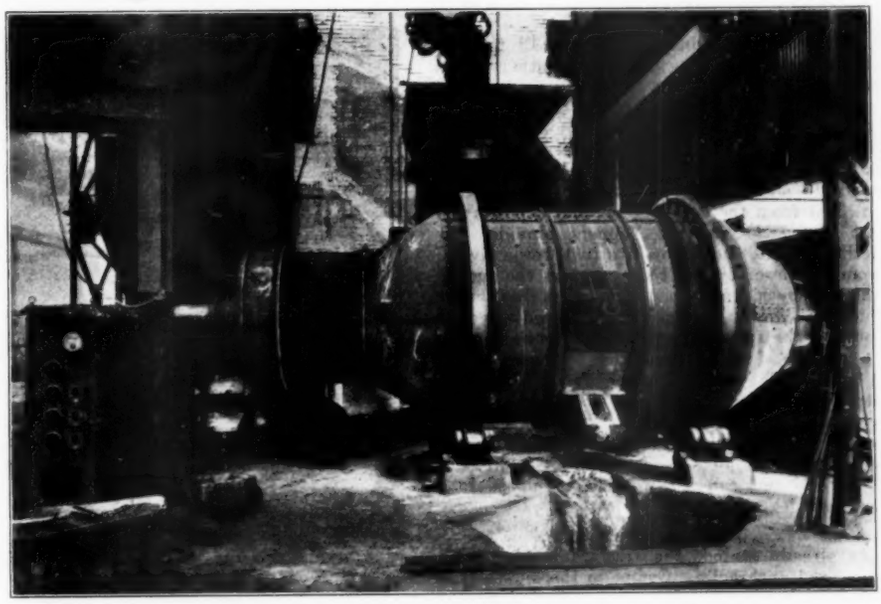

FIG. 2.—SIDE VIEW OF FURNACE SHOWING TAPPING SPOUT AND POSITION OF CONTROL PILLAR.

The "Sesci" Furnace.

The furnace itself is of the simplest possible construction, consisting of a cylinder built up of steel plates, which are suitably reinforced. The lining is a special refractory, very high in silica, which is rammed against the steel shell; joints are thus avoided, and the lining can therefore withstand the variations in temperature inseparable from irregular working. The furnace is cone-shaped at either end, and firing takes place at the one end while the gases are exhausted from the opposite end. The furnace is made to rotate or to oscillate by means of two roller paths resting on rolls fitted with roller bearings. The burner which is fixed solidly to the furnace and rotates with it, is of a special type with which combustion starts at its very base and is complete before the cylindrical portion of the furnace is reached. At the other end of the furnace a movable exhaust box is provided, suitably lined with refractory material. It is mounted on a bogie and normally guides the hot gases from the furnace to the flues. Operated by the charging gear, it is a matter of a few seconds to uncover the charging end of the furnace after a melt has been tapped.

Having briefly described the furnace proper, it will simplify our description, and also add to the interest, if we deal specifically with the particular installation, the general arrangement of which is shown in Fig 3, from which it will be seen that the furnace is served by a 35-ton crane, whilst a 10-ton trolley hoist travels on a beam runway which is extended so that it may serve an extension to the melting plant. The position of the plant relative to the receiving point for the coal was determined by the foundry lay-out, it being, of course, desirable to place the new furnace in line with the existing cupolas. We need, however, only deal with the fuel from its delivery to the plant.

Fuel Preparation.

The conveyor delivers into a storage hopper above the grinding unit. This hopper has a storage capacity for 30 tons and is divided off as to 18 tons of anthracite and 12 tons of bituminous coal. From this hopper either of the coals is fed by handwheel-controlled valves, over a magnetic separator to a "Rex" atomiser in which the coal is pulverised so that 98 per cent. will pass a 200 mesh. The pulveriser fan blows the fine coal through a preliminary cyclone and thence to a dust-bag filter which separates the coal dust from the carrying air and deposits the dust into either of two hoppers provided for the bituminous and anthracite fuel, respectively. From the lower end of these hoppers the fuel is taken up by means of a double-screw distributor which is driven by a variable-speed electric motor. The speed of rotation and consequently the rate of feed is regulated by means of a rheostat. The fuel delivered falls by gravity into the hot-air pipes through which it is carried to the burner. The air necessary for combustion is furnished by a Roots blower, which is driven by a variable-speed motor. The mixture of air and fuel can therefore be regulated to a very fine degree.

Method of Firing.

As already stated, the furnace is fired with pulverised anthracite. Owing to the low-volatile content, the furnace has to be started up on bituminous coal, hence the double storage. The firing is steady from the outset of the operation, even when starting from completely cold, and rotation of the furnace commences from 5 to 6 min. after lighting up. After about 15 min. the air for combustion is hot enough to permit working with anthracite, the bituminous-coal supply being then cut off.

There are, of course, obvious advantages incidental to the use of a fuel with low-volatile content. The flame is short and consequently combustion is complete before the zone of the furnace is reached. There is thus no contamination of the metal, either by carbon or oxygen, and in practice it has been found that the amount of sulphur taken up by the metal is negligible. It is generally agreed by combustion engineers that the flame produced by a fuel containing 5 per cent. volatile is approximately 120 deg. C. higher in temperature than that of a coal of similar calorific value with 30 per cent. volatile. There is, however, the even more important consideration of the waste heat. With the low-volatile fuel air for combustion may be

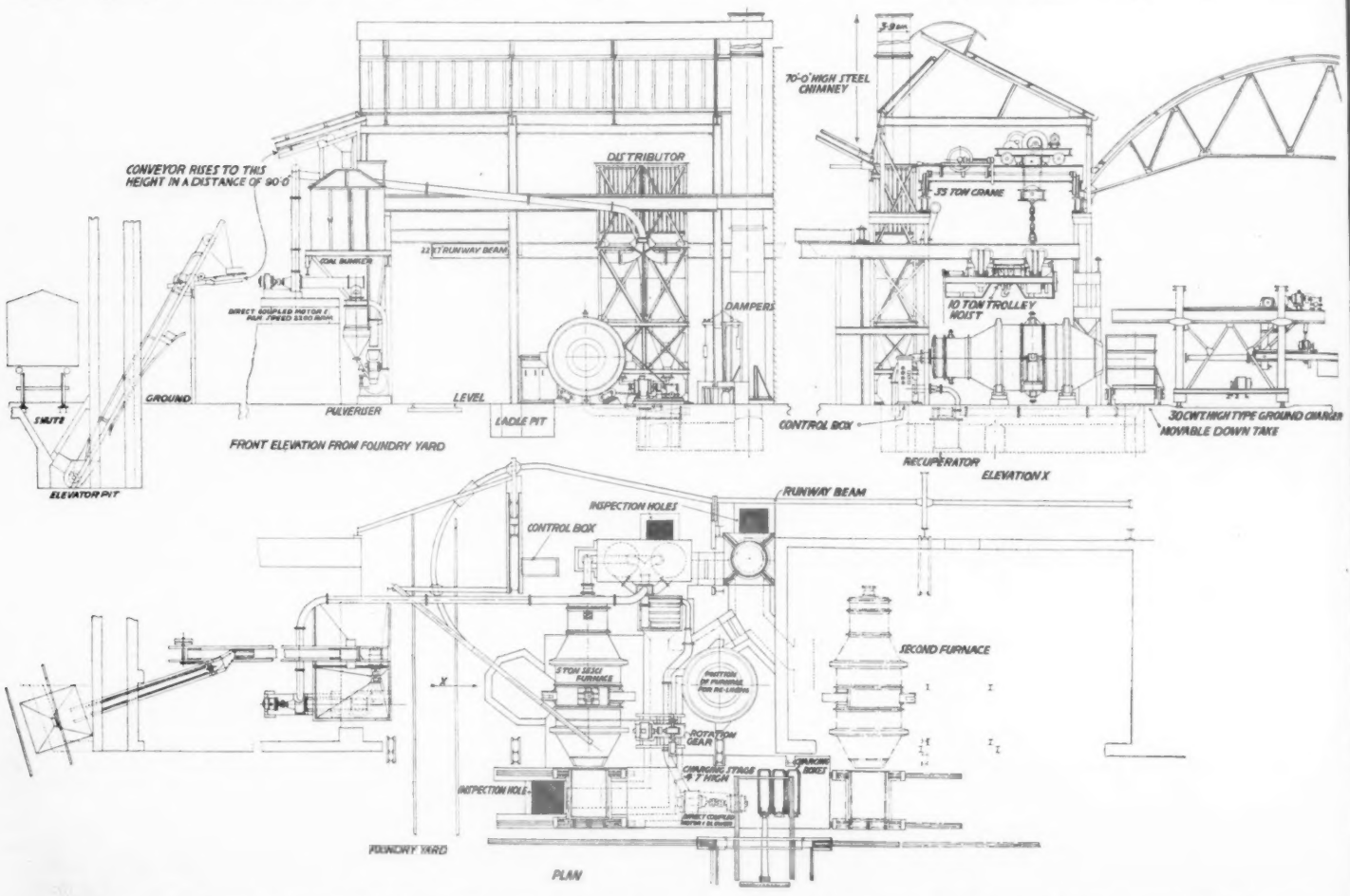

Fig. 3.—Elevation and Plan of the "Sesci" Melting Furnace Installation at the Foundry of the National Gas Engine Company, Limited.

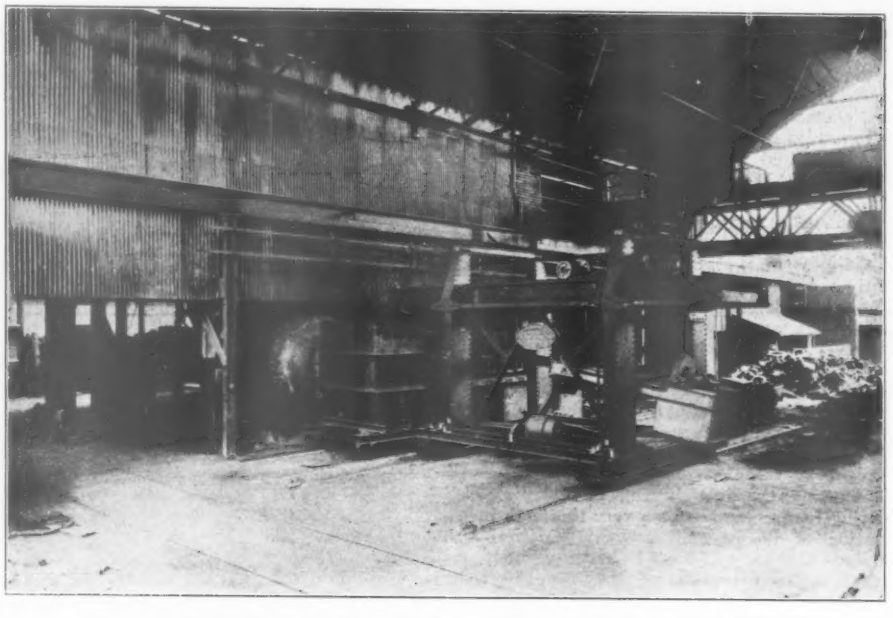

Fig. 4.—Furnace under Melting Conditions. Exhaust Box in position.

preheated up to, say, 425 to 600 deg. C., whereas with the coal of the higher volatile content it would not be practical to carry preheating beyond 210 deg. C. It will thus be seen that the employment of anthracite effects a saving in fuel through the recovery of the surplus heat and also adds another 150 deg. C. to the temperature of the flame.

The hot gases are sent into the flue through the movable exhaust box and directed towards the recuperator; a by-pass enables a part or the whole of the hot gases to be sent direct to the chimney so that the temperature of the recuperator can be controlled. Normally, the recuperator reintroduces into the furnace roughly 30 per cent. of the calorific power of the fuel consumed.

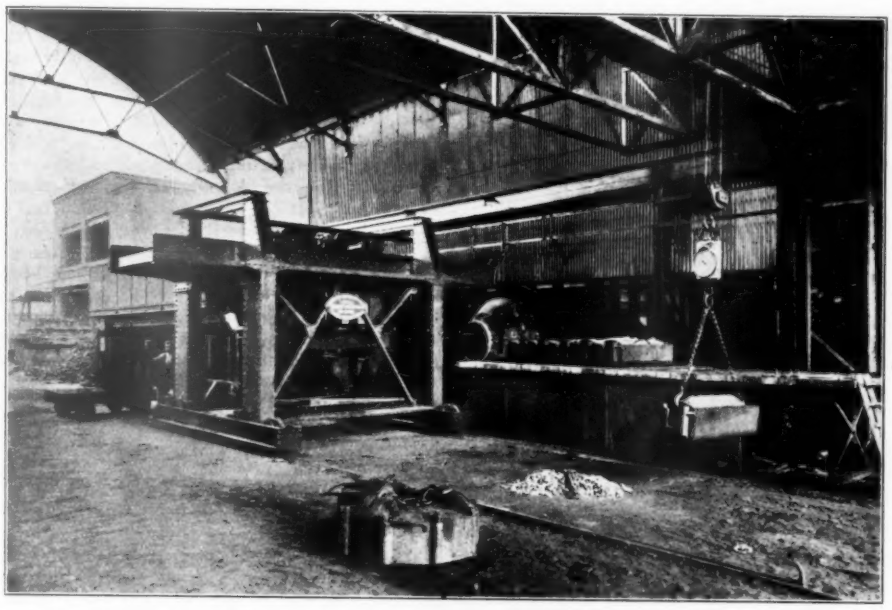

Fig. 5.—"Sesci" Furnace being Charged.

The pulveriser is direct-driven by a 30-h.p. motor, the fan working in conjunction with the pulveriser by a 20-h.p. motor and the Roots blower by a 15-h.p. motor. The furnace body is rotated by a chain drive through a gearbox by a motor of 5 h.p. The whole of the instruments for controlling feed, speed and temperatures are installed on a pillar, on the fuel side, but distant from the furnace.

Charging Machine.

The arrangement of the high-ground type 30-cwt. charger supplied by Joseph Adamson (Hyde, Manchester) will be understood from Fig. 5. It consists primarily of a steel bridge carried on four travelling runners, two of which are driven by a cross shaft and reduction gear from a 15-h.p. 600 r.p.m. motor, the speed of travelling being 250 ft. per min. The uprights of this structure are of rigid construction, well plated to withstand the severe cross strains which are imposed when the machine is travelling with the charging box at the extreme position. Carried from the legs of the main structure are the cross girders, which are arranged with rails on top and bottom for the travelling cross carriage to run upon. The bridge girder is substantially supported in the horizontal direction and strongly connected to the main legs by large gussets.

The travelling cross carriage consists of a mild-steel frame from which an inverted "A" frame hangs, from which the charging arm and cab pivot are supported. The traversing of the cross carriage is effected by gearing operated by a 5-h.p. 600-r.p.m. motor, the drive being arranged at the front of the carriage, giving a speed of 80 ft. per min. From the rear portion of the charging arm a connecting rod is connected to the crank shaft which is located on the top cross frame. This rocking arm is actuated by worm reduction from a 5-h.p. 600-r.p.m. motor and gives a speed of 7 r.p.m. A powerful electric-magnetic brake is fitted to ensure the operator having full control of the arm movement.

Turning of the box in the furnace is by means of a spur rotating gear which is placed at the back of the charging arm and operated by a 5-h.p. 600-r.p.m. motor, which gives a speed of 14 r.p.m. Near this gear and placed in the cab is the bar-locking mechanism which is operated by toggle links.

The supply current is 240 volts direct current. The controllers, operating gear and panel are in excellent positions for the operator to ensure quick and rapid handling of this machine to give the maximum output. All the wiring is run in steel-covered pathways, which eliminates the possibility of cut cables whilst they are easily accessible for testing.

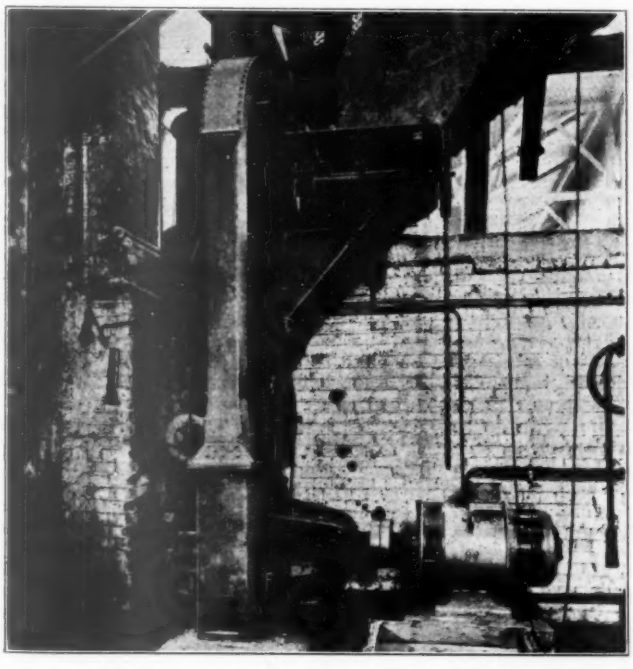

Fig. 6.—Pulverising Unit showing Feed Hopper with Preliminary Cyclone in rear on left.

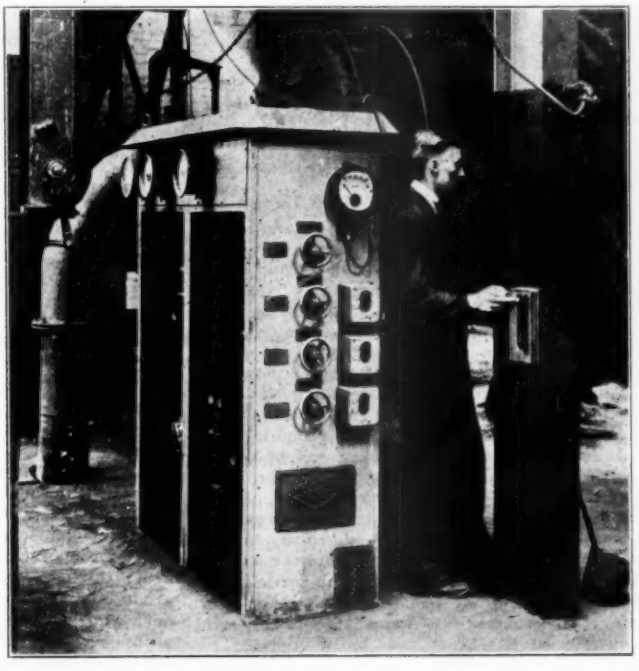

Fig. 7.—General Arrangement of Control Pillar and Push-Button Control.

Operation of the Furnace.

Assuming that the furnace is starting up from cold. The exhaust box is moved clear of the charging opening and the charge is deposited.

(*Concluded on page* 139.)

A Revolutionary Method in Moulding Practice.

THIRTEEN-FOOT LONG ROLL CAST WITHOUT BOX PARTS.

Mr. Louis Maillard in the July "Bulletin of the French Foundry Technical Association" has described in considerable detail a novel method of making iron and steel castings which utilises a sand-cement mixture of such a character that boxes and drying stoves are eliminated. It is a matter for regret that several of the illustrations used by Mr. Maillard are unsuitable for reproduction. In the course of his Paper—which, by the way, will be presented next week in Paris to the International Convention—the author states that experience has shown that when prepared under defined conditions moulds made from a moist mixture of sand and cement which, after setting, is quite suitable for receiving liquid metals and alloys, as, for example, steel, bronze, cast iron, aluminium, etc., and of giving sound and dimensionally-correct castings. The successful development of the industrial application of the method of moulding, based on such a mixture, has necessitated studies, some of which sand and their inclusions form the object of this

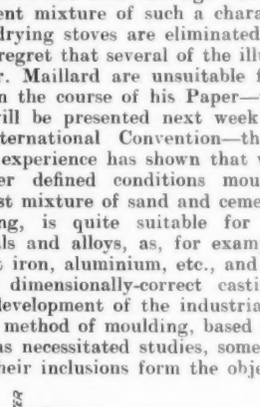

Fig. 1.—Permeability after 48 Hours of a Mixture of 100 Parts of Silica Sand and 15 Parts of Portland Cement by Weight prepared with Increasing Quantities of Water.

present Paper. Branded Portland cements and super cements start to soften at temperatures higher than 1,500 deg. C., some indeed above 1,700 deg. C., and their melting temperatures are not less than 1,600 deg. C. Sand, on the score of refractoriness at these temperatures, should, moreover, be free from impurities liable to cause reactions with the metal or to give fusible combinations with the constituents of the hydraulic cement. Moreover, they should not impede or retard the setting or the hardening of the cement. From this last point of view clay-bonded sands are ruled out. Siliceous sands respond satisfactorily to the above stipulations and are in practice the most usually employed. One can substitute on occasion pulverised coke, quartzite, zerconite, crushed chromite, refractory bricks or ground-up old moulds of the sand-cement mixture.

Moisture Control is Essential Factor.

It is, therefore, readily understandable that such a mixture of sand and cement can be used as a refractory at normal foundry temperatures. The necessary quality of permeability in all material for moulds and cores can be obtained with ease by the utilisation of this sand-cement material through the controlling of the well-defined conditions of the hydration of the mixture. Fig. 1 outlines the curve of permeability taken 48 hrs. after their making of a series of moulds (10-cm. cubes) made from a mixture of 100 parts of silica sand and 15 parts of Portland cement by weight, with increasing water conditions from 2½ up to 20 per cent.

Permeability Control.

The measurements of the permeability was made by the use of the apparatus shown in Fig. 2, which also shows the method of regulation and operation. The pressure figures read on the manometer vary indirectly with the permeability of the mould in the portion under test.

This apparatus has no pretensions to be a precision instrument, but it does return figures of practical utility. Its portability allows it to be used on actual moulds in the foundry giving their permeability more or less relatively and to control the manufacture of the moulds. Under the conditions which governed the establishment of the curve in Fig. 1, experience indicated a limit of permeability corresponding to the maximum pressure of 800 grams on the manometer for day-to-day moulds in the iron and steel foundry. Outstanding is the rapid drop of the curve in Fig. 1, where the percentage of water exceeds 10 per cent. The maximum results are obtained with 7 to 10 per cent. water and every effort is made not to exceed this latter figure. The plastic consistency of bricklayers' mortar is obtained with the above mixture having a degree of humidification in the neighbourhood of 20 per cent. wherent the permeability approaches zero.

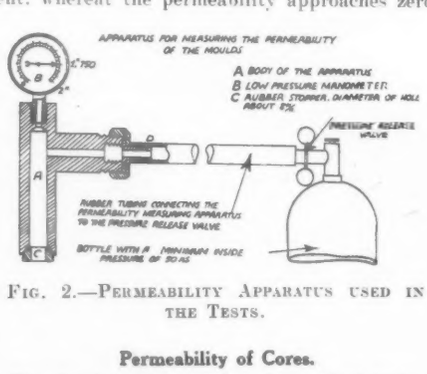
APPARATUS FOR MEASURING THE PERMEABILITY OF THE MOULDS
A BODY OF THE APPARATUS
B LOW PRESSURE MANOMETER.
C RUBBER STOPPER. DIAMETER OF HOLE ABOUT 8%
PRESSURE RELEASE VALVE
RUBBER TUBING CONNECTING THE PERMEABILITY MEASURING APPARATUS TO THE PRESSURE RELEASE VALVE
BOTTLE WITH A MINIMUM INSIDE PRESSURE OF 50 AS

Fig. 2.—Permeability Apparatus used in the Tests.

Permeability of Cores.

Fig. 3 relates to a series of practical tests of permeability carried out in the core shop in the following manner. A number of square bars of 5 × 5 cm. section and 36 cm. long, was made with a mixture of six parts of sand and one part of Portland cement by volume to which increasing quantities of water were added.

These samples were immersed progressively at the speed of 5 cm. per sec. in liquid iron contained in a foundry ladle, until a boiling phenomenon appeared. The depth of the corresponding immersion was noted as it gave an idea of the practical permeability of each specimen; thus up to the point where boiling was produced, the gas evolved from the submerged part and of which the quantity produced by unit of volume increases with the degree of hydration, can escape entirely through the section of the test sample situated in the plan of the surface of the bath of metal. The lower permeability curve of Fig. 3 relates to tests carried out two days after the making of these bars, and the upper curves those carried out after five days. A third curve gives the tensile strength of the samples after five days air drying. From the nature and the granular make up of the sand used in the tests shown in Fig. 3 (sand from old moulds made from a crushed sand-cement mixture), the practical moisture content to note in the making of mould sand cores corresponds to a ratio given by $\frac{\text{water}}{\text{sand}}$ by volume ranging between 0.7 and 0.9. A moisture content giving the plastic consistency of bricklayers' mortar corresponds to a value of 1.4 of this same ratio, the permeability being then virtually zero. It is to be noted for the range of hydration utilisable in foundry practice a distinct improvement in the permeability occurs after five days as against that for two days. This observation is of outstanding importance for cores and for the delicate portions of moulds.

A Practical Test.

Confirmation of the pointers given by the tests set out in Fig. 3 have been furnished by the casting in iron of 6 series of cylinders and discs moulded in the same mixtures as the test samples of the preceding experiments, that is 6 parts of sand and 1 part of Portland cement by volume with the following increases in moisture content:—

Sample Number	0	I	II	III	IV	V
$\frac{\text{Water}}{\text{Cement}}$	0.35	0.72	0.9	1.05	1.2	1.35

Casting took place 48 hrs. after moulding with having neither any facing applications nor stoving. Moulds No. 0 lacked cohesion through insufficient moisture content and the disc was not able to be cast, whilst the cylinder showed surface cracks. The castings Nos. 1 and 2 were

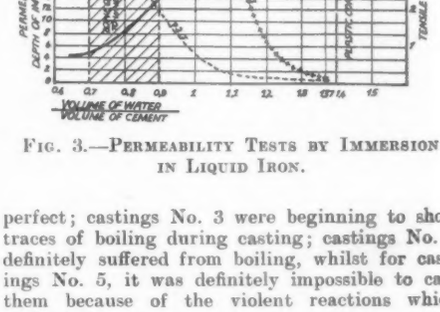

Fig. 3.—Permeability Tests by Immersion in Liquid Iron.

perfect; castings No. 3 were beginning to show traces of boiling during casting; castings No. 4 definitely suffered from boiling, whilst for castings No. 5, it was definitely impossible to cast them because of the violent reactions which took place.

These results confirm the practical moisture limitations set out above.

Permeability from Moisture Control.

From these various experiments it can be postulated that the degree of the hydration of the sand-cement mixture assure that moulds will have the maximum permeability, whilst those made from material having the consistency of bricklayers' mortar will be definitely inferior. Moulds made from preferably prepared sand-cement mixtures are a type of extra weak, underhydrated mortars. The characteristics of such mortars vary with the granulation of the sand, the water content and the quality of the cements used. It can be stated that for the mixtures utilised in the above experiments the tensile strength is of the order of 14.2 lbs. per sq. in. after two days and twice to three times that figure after 5 days. The crushing strength is of the order of 70 to 140 lbs. per sq. in. after two days and 140 to 210 lbs. per sq. in. after 5 days. The laboratory of the Société des

Chaux et Ciments de Lafarge et du Teil has studied mixtures of this type and has come to the following conclusions. A mixture of a 100 parts of large grained sand ranging from 1.5 and 2 mm. dia., 15 parts of Valdonne artificial cement and 8 parts of water by weight gives a crushing resistance of 560 lbs. per sq. in. after two days. An identical mixture but using as a base fine Piolenc sand also shows a crushing strength of 560 lbs. per sq. in. after 2 days. A mixture of 100 parts of Piolenc sand, 10 parts of "cement fondu" and 8 parts of water give 620 lbs. per sq. in. crushing strength after 2 days.

Wide Range of Material Available.

The above figures show that from the choice of materials it is possible to vary the strength of the mould materials made from a cement base between very wide limits, while at the same time containing ample permeability. The crushing strength shown by the moulds after setting are in practice unrelated to any degree of ramming put upon the moulds during their making and in every case are easily sufficient to make a face strong enough to resist any ferro-static pressures normally encountered in foundry practice.

Degree of Ramming of No Importance.

It is possible to do this with ease and speed without introducing dangers of defects due to incorrect ramming. After a certain period for setting, ranging from a few hours to a day or two, according to the importance of the mould, the sand-cement material takes on a consistency so that the manipulation of the parts of the mould can be made without the necessity for moulding boxes. The resistance to crushing of this sand-cement is in practice always sufficient to withstand any compressive forces encountered in moulding practice, such as pulling forces which can be taken care of by wrought-iron reinforcement bars, which may be either straight or bent and judiciously arranged in the sand-cement, where, after setting, they behave like true reinforcing bars in ferro-concrete, and can be calculated and established according to the precepts of that branch of engineering. The use of box parts, therefore, does not arise from the point of view of the reinforcement of the mould, and from this factor there is a possibility of the general application of what is known as "boxless" moulding.

Large Castings Made Without Boxes.

Some foundries currently practising their casting in boxless moulds made from sand-cement for both iron and steel castings of all weights and dimensions right up to 15 tons. The author has illustrated a mould ready for the casting of a steel roll of 27½ in. dia. and 13 ft. long, and the assembling and the mould ready for casting, of a Pelton wheel part in steel.

Casting Conditions.

Moulds made in sand-cement under proper conditions of hydration are not stoved before casting. After exposure to free air for a period varying with the dimensions of the moulds, the cement used and the atmospheric conditions, the normal time is two days for average-sized moulds. The phenomena of setting and superficial drying are sufficiently well known to allow the moulds to be assembled and to receive the metal under good conditions. In fact, the material is still damp at the moment of casting, this being shown by the copious evolution of vapour; thus, true green casting is applicable with success to all metals, steel included, and for all thicknesses, due no doubt to the extreme permeability of the moulds, which assures the easy evacuation of all gas liberated from the mould material. For the same reason, surfaces are obtained free from such defects as "scabs" attributable to gas evolution of the sand wall of the mould. The elimination of stoving does away with deformations in the moulds and cores attributable to this operation, and "precision" assembly becomes assured. Good ordinary foundry facings can be used on the mould surfaces, the underhydrated and very hydroscopic nature of the material absorbs in a few hours the water of the facing, which brings about conditions of dryness essential for such facings to function. It will be appreciated that the sand-cement, because of its permeability, is particularly suitable for the making of cores. There naturally arises the question as to the compressibility of the material during the contraction of the metal. Experience has shown, however, that under the influence of the heat released by the freezing casting, the sand-cement possesses a compressibility greater than that of clay-bonded sands.

Oil Sand Compositions Used.

In practice the majority of the cores is successfully made in sand-cement without special precautions. On the other hand, for delicate cores or those parts of moulds which have to resist indeterminate forces during contraction, recourse is made to methods analogous to those often used with linseed-oil sands; thus the moulds can be constructed of a shell of sand-cement in contact with the metal and a backing of ordinary plastic aerated sand. The thickness of such a shell should be related to the temperature conditions and the pressures from contraction to which the mould is liable to be submitted. Sand-cement is a synthetic sand, constant in its composition, and simple in its preparation. Compared with artificially-bonded sands, it presents certain economic and technical advantages, such as (1) reasonable price of cement as a binder, (2) elimination of stoving, (3) high strength, (4) ease of reinforcement, permitting boxless moulds of all dimensions to be made, and (5) the conservation intact of the shapes of the parts of the moulds and cores, allowing of easy precision assembling of the moulds without any mends. The consistency during moulding is similar to that of the oil-sand type, and the same methods of moulding are thus used in order to take care of a cohesion of which is lower than that of clay-bonded sands. Patterns and core boxes are always in good condition, and, when suitably varnished, allows of the use of turnover moulding machines for stripping the patterns, and also eliminating any hand-mending, which is always a highly-skilled and arduous task. The material permits of the use of the strickle method of moulding where large castings have to be made in the floor. Sand-cement readily lends itself to the application of modern methods of working; by this is meant that the methods of carrying out the job and the preparation of all the details of patternmaking and moulding is transferred to the management.

Can the rational field of application of sand-cement moulding, so far as it concerns foundry practice, be defined? It is useless to imagine that it will replace green-sand moulding for the mass production of large quantities which justifies a special organisation and lay-out to assure intensive production on semi-automatic lines, but it does seem possible that it may replace all other types of foundry work, and especially dried-sand moulds. At the present time a dozen French iron and steel foundries are normally moulding in sand-cement for all, or a part of, their manufactures. The production of castings so moulded represents several thousands of tons annually. A certain number of other foundries are studying this method of moulding with a view to adopting it.

The Wharfedale Foundry, at Otley, occupied until recently by Messrs. Fieldhouse, Crossfield & Company, Limited, was offered for sale by auction as a going concern last week, and was withdrawn at £3,500. The buildings were then offered and withdrawn at £2,000. Later the plant and machinery were disposed of piecemeal.

Catalogue Received.

Corrugated Sheeting, etc.—We have received from Lysaght Protected Steel Company, Limited, Orb Iron Works, Newport, Mon, a 24-page catalogue carried out in a variety of coloured printing made necessary to illustrate the range now available in the matter of the provision of roof sheeting. This novel and interesting development relates to the provision of sheeting the outside of which is coated with a coloured (green, russet, black or grey) abrasive sort of a material, and the inside with green, grey, sunlight or aluminium finish. In addition to the four colours enumerated it is made in five gauges from 18 to 26. We are asked to make suggestions to enhanced application, and one immediately comes to our mind. That is, for the parapets of bridges; some railway companies ask for grey-iron castings to be stone finished—this, we presume, is to prevent its desecration by small boys armed with chalk. Cast-iron urinals are also frequently stone finished. We note from page 23 that a special catalogue is devoted to guttering, and presumably made from treated steel strips. If this proves to be superior to cast iron around cupola furnaces, and although it is distasteful for us to write it, they might usefully be given a trial if economies can be shown. The brochure is a great credit to those responsible for its production, as it contains the exact type of information which should be included. By this we mean practical hints on ordering, handling, storage and erection. We presume that it is available to our readers on request.

The "Sesci" Melting Furnace.

(*Concluded from page* 137.)

The boxes with their burden are carried on a stage at the side of the furnace, so that the complete charge can be loaded into the furnace in a few minutes. The exhaust box is moved back into position and the furnace lighted up, as previously described. An automatic contactor controls the rotation of the furnace in each direction. The angle of rotation may vary from 45 to 360 deg. by which means the furnace may be made to oscillate slowly at the commencement of the melt, and towards the end to describe a complete rotation, reversed at each turn. It will thus be seen that the metal comes in contact successively with every part of the refractory lining, cooling those parts which have just been heated by the gases, and, on account of this fact, gases of very much higher temperature can be employed than in a non-rotary furnace.

The whole of the preheated combustion air and the pulverised fuel enter the furnace through a turning joint which is absolutely tight, so that the mixture of air and coal cannot be modified or chilled. The furnace is provided with a tapping lip and a further tapping lip for the evacuation of the slag, which pours off easily because of its extreme fluidity. Samples may be taken from the tapping hole at any moment for analysis of the metal without stopping or retarding the operation of the furnace.

From cold, the time taken from charging to tapping is approximately 3 hrs., subsequent charges being brought down in 2 hrs.

The "Sesci" furnace is placed upon the market by Messrs. Pittevil & Company, of Windsor House, Victoria Street, S.W.10.

The Tee-side Bridge & Engineering Works, Limited, Middlesbrough, has received several substantial orders for constructional work. The two most important are two spans, each 60 ft. long, to form a steel bridge over the Tugela River, South Africa, and for a steel suspension bridge with three 60-ft. spans over the Potaro River, British Guiana. The works will be kept busy until the end of the year.

Shop Method for Determining Volume Changes in Cast Iron During Casting.*

By E. J. Ash and C. M. Saeger, Junr.

Introduction.

The Bureau of Standards, in co-operation with the American Foundrymen's Association, has recently made a study of methods for the determination of volume changes in metals during casting. The factors involved in the shrinkage of metals, methods used by other investigators, methods used and data obtained on the volume changes of a number of non-ferrous metals and a series of cast irons have been presented previously.[1, 2, 3]

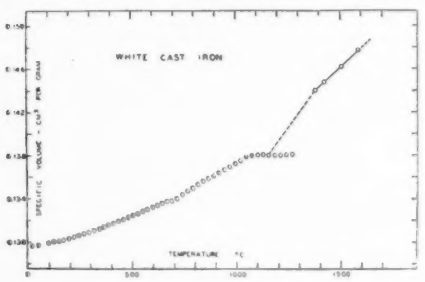

Fig. 1. — Specific Volume-Temperature Relation of a White Cast Iron.

It was pointed out that most of the unsoundness in a casting is produced during the solidification of the metal.[1] Alloys having a long freezing range and large volume change during solidification are more susceptible to shrink holes and porosity, and more care is required in the gating and feeding of such alloys than in those having a relatively short freezing range and small volume changes during solidification. A knowledge of the volume change during solidification of the metal is essential to the production of sound castings.

The overall shrinkage of a metal cooling from the liquid to the solid state at room temperature can be divided into three parts—(1) shrinkage in the liquid state, (2) shrinkage during solidification and (3) shrinkage in the solid state. This is illustrated in Fig. 1, which shows the volume changes in a typical white cast iron determined by the method previously described.[3, 5] These volume changes were calculated from the specific volumes at the various temperatures.

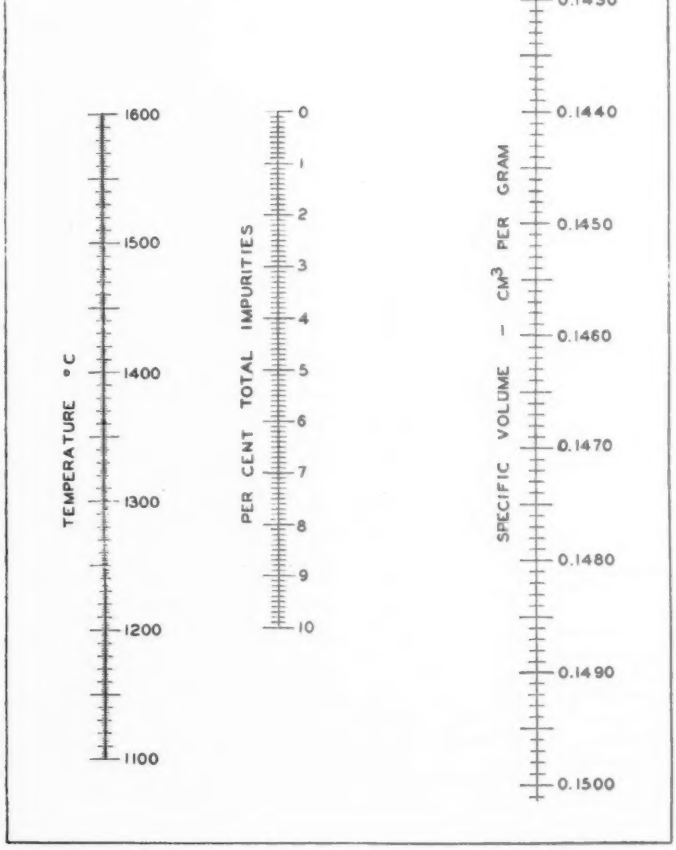

Fig. 2.—Alignment Chart for Determining the Specific Volume of Liquid Cast Iron.

The determinations of the specific volume of cast iron at elevated temperatures requires careful manipulation. Consequently, an indirect method based upon data obtained in the previous study of 12 commercial cast irons has been developed, by means of which it is believed volume changes in irons during casting can be determined in the foundry quickly and with sufficient accuracy for all practical purposes. The composition of the cast iron and the linear contraction in cooling from the freezing temperature to room temperature are all that need be determined in the foundry.

Method.

The successive volume changes undergone by a metal or alloy during casting are best expressed in terms of the changes in specific volume with change in temperature as the metal cools from the liquid state to room temperature. As the shrinkage of a metal during casting takes place in three stages, the method for determining the volume change during each stage will be considered separately.

The rate at which cast iron shrinks whilst in the liquid state can be determined by means of Fig. 2. The alignment chart shows the relation between specific volume and the temperature for irons of different amounts of "total impurities" and is based on the data obtained

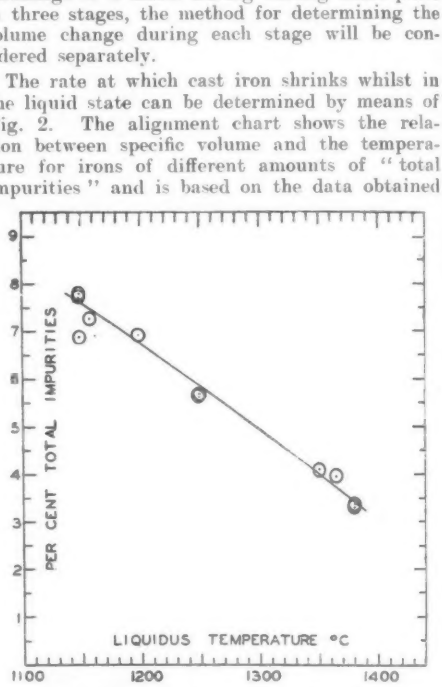

Fig. 3.—Relation of Liquidus Temperature to Total Impurities in Cast Iron.

in previous study of twelve commercial cast irons ranging from white to grey. The term "total impurities," is used throughout this Paper to express the summation of common constituents of cast iron, carbon, silicon, phosphorus, manganese and sulphur.

Shrinkage in the liquid state, for a given cast iron, is determined by the difference in the specific volume at any temperature in the liquid state, and at the liquidus temperature (beginning of freezing or solidification). The liquidus temperature for a cast iron of known composition can be determined from Fig. 3 with sufficient accuracy. This curve is based upon the experimental determination of the liquidus temperature for 12 melts of cast iron. The liquidus temperature for any cast iron whose amount of "total impurities" lies within the limits given can be readily determined from this curve. On the basis of previous work, 1,150 deg. C. has been taken as the temperature of the solidus (end of freezing) of cast iron.

The shrinkage taking place during solidification is the difference between the volume at the liquidus (temperature of beginning of solidification) and at the solidus (temperature end of solidification). It is calculated from the difference in specific volumes at these two temperatures. The method for obtaining the specific

* A Paper approved by the Director of the American Bureau of Standards and presented to the Detroit Meeting of the American Foundrymen's Association. The Authors are on the Staff of the former body.

1 C. M. Saeger, Junr., and E. J. Ash. "Transactions" A.F.A. Vol. 38, page 107.

2 C. M Saeger, Junr., and E. J. Ash. "B.S. Jour. Research." Vol. 8, page 67.

3 E. J. Ash and C. M. Saeger, Junr. "B. S. Jour. Research." Vol. 8, 1932.

volume at the liquidus temperature has just been given. The specific volume at the solidus temperature is determined by the specific volume at room temperature and the cubical contraction in the solid state.

Cubical contraction is three times the linear contraction. The linear contraction of any cast iron may be determined conveniently by casting in sand a bar of the design shown in Fig. 4. A pattern of this shape has an advantage over the form ordinarily used in that rapping is not required in removing it from the sand. The difference in the dimension A-B of the pattern and the corresponding dimension of the casting is the linear contraction per foot of metal. The volume changes at room temperature (25 deg. C.) of the twelve melts of cast iron were determined experimentally and are plotted against the per cent. of total impurities in Fig. 5. The specific volume at room temperature of any cast iron whose amount of total impurities lies within these limits can be obtained from this curve.

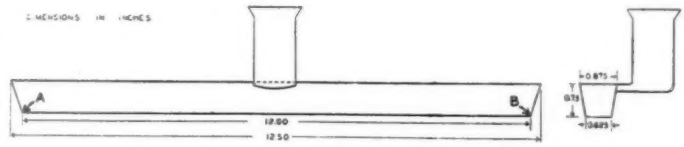

Fig. 4.—Bar for Determining Total-Linear Contraction of Cast Iron. The Dimensions given are Arbitrary.

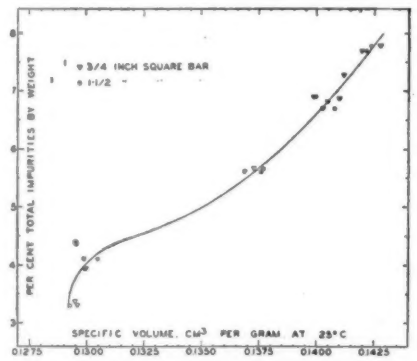

Fig. 5.—Relation between Specific Volume of Cast Iron at Room Temperature and Total Impurities.

Application of Method.

An example of the application of the above method for the determination of the total shrinkage undergone during casting by an iron of the following composition, whose linear contraction has been determined to be 0.12 in. per foot is:—T.C., 3.25; Si, 2.00; Mn, 0.50; P, 0.70; S, 0.05 per cent. The specific volume of this iron, having total impurities of 6.5 per cent. can be determined for any temperature in the liquid state from Fig. 2. For 1,450 deg. C., for example, a straight line passed through the points corresponding to 1,450 deg. C. and 6.5 per cent. impurities, respectively, intersects the third or specific volume scale at 0.1488. The specific volume of this iron at 1,450 deg. C. is, therefore 0.1,488 c.c. per gram.

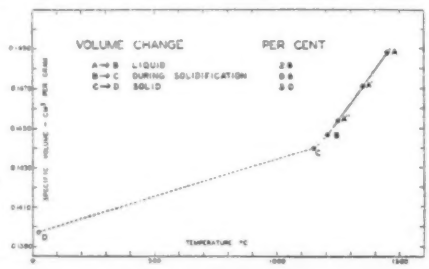

Fig. 6.—Volume Changes in a Typical Grey Cast Iron as determined by the Method described in this Article.

Likewise, the specific volume of this iron at 1,350 deg. C. will be found to be 0.1,471 c.c. per gram.; and at 1.250 deg. C., 0.1454 c.c. per gram. These values correspond to the points A, A′, and A″ on the curve of Fig. 6.

According to Fig. 3, the liquidus temperature for an iron containing 6.5 per cent. total impurities is 1,210 deg. C.—point B, Fig. 6. The specific volume corresponding to this temperature is 0.1,447 c.c. per gram. The portion A-B of this curve (Fig. 6) represents the change in specific volume (contraction) of the liquid metal on cooling from 1,450 deg. C. to 1,210 deg. C., the beginning of solidification. This amounts to:

$$2.8 \text{ per cent.}\left(\frac{0.1488-0.1447}{0.1488}\times 100=2.8 \text{ per cent.}\right)$$

The change in the specific volume (contraction) from 1,150 deg. C. to end of solidification to room temperature is determined as follows:—According to Fig. 5 the specific volume at room temperature of an iron containing 6.5 per cent. impurities 0.1,397 c.c. per gram (Point D, Fig. 6). The specific volume of the solid metal at 1,150 deg. C. is calculated from the linear shrinkage which for this iron was found to be 0.12 in. per ft. or 1 per cent. Therefore the cubical contraction is 3 per cent. The specific volume of the iron at room temperature is therefore 97 per cent. of specific volume at 1,150 deg. C. Hence the specific volume at 1,150 deg. C. is 0.1,397 ÷ 97 or 0.1,440 c.c. per gram (Point C., Fig. 6).

The shrinkage during solidification is numerically equal to the difference between the specific volume of the liquid iron at 1,210 deg. C. – 0.1,447 c.c. per gram of the specific volume of the solid iron at 1,150 deg. C. – 0.1440 c.c. per gram. This amounts to 0.6 per cent.

$$\left(\frac{0.1447-0.1440}{0.1447}\times 100=0.6 \text{ per cent.}\right)$$

American Steel Foundry Practice Surveyed.

Mr. W. C. Hamilton, Research Director to the American Steel Foundries, opened the Symposium on Steel Castings recently held at Atlantic City, N.J., by a general survey of the American steel-castings industry. Several features in the picture he drew have interest for British readers, as showing divergencies in the development of this industry in the two countries. For instance, the electric-arc furnace was introduced into the steel-casting industry in America in 1909, when approximately 306 tons were produced. The output of converter steel for castings, at that time, was approximately 33,928 tons, crucible steel approximately 12,527 tons and open-hearth steel about 600,891 tons. The progress made during the past 20 years in electric steel melting in the foundry and elsewhere is a matter of fairly common knowledge among industrialists. Naturally, the increase in the number of electric furnaces for making steel castings has been accompanied by a decrease in the number of converters utilised for the same purpose. To-day, the converter, like the crucible-pot furnace, may be said to have reached a stage of little commercial importance. Operations of the converter are handicapped by a large loss of metal through the oxidation that takes place in the cupola and, to an even greater extent, in the converter. In contrast, the electric furnace melts metal with relatively small oxidation losses. This fact somewhat balances the high initial cost of the electric-arc furnace and its high cost of operation. A gradual reduction of cost for electric power in many localities has resulted in giving the arc furnace its present economic position. The arc furnace has been employed in the United States for steel-casting production, with both basic and acid linings, preference generally being for the acid-lined unit, due very largely to its greater simplicity of operation. For certain grades of alloy steels, the basic furnace is preferred, as with it there are less melting losses of the alloys used. To-day the proportion of cast-alloy steels made in America probably amounts to 20 per cent. of the total. The latest development in the adaptation of electric furnaces for the steel-casting industry is the high-frequency induction unit, which has acquired a position of importance for the production of high-alloy steels for castings. It is especially suitable for producing alloys having extremely low-carbon contents.

The customary size of open-hearth furnaces for steel foundry use is approximately 22 tons. Most of the electric-arc furnaces, and the majority of the converters which they displaced, are of 3 tons rated capacity. Individual furnaces readily take a heat charge varying from a few hundred pounds to five tons in weight. The high-frequency induction furnaces used in the steel foundry range from 500 lb. to slightly over one ton in rated capacity. There is a great variety in the products made regularly in steel foundries. These range in thickness from approximately ¼ in. to as much as 4 ft., and run in weight from a few ounces to huge sizes, requiring the simultaneous tapping of several open-hearth furnaces in order to provide sufficient metal. Probably the largest steel casting ever produced was made in an American foundry during the last year. The weight of the finished casting was 208 tons. Within the extremes of member-thickness and weight mentioned, there is an infinite variety in overall dimensions. Engine-bed castings are successfully produced, having lengths of 65 ft., and members of intricate design serve to complicate manufacture.

According to the statistics compiled by the American Iron and Steel Institute, there were less than 192,857 tons of steel castings made in the United States in the year 1900. By 1929, the total output of the industry had mounted to 1,582,035 tons. A few figures to show the development of alloy-steel production in the foundry are interesting. Data accumulated by the American Iron and Steel Institute showed less than 29,465 tons of alloy-steel castings as having been manufactured in the United States in 1910. By 1929, the output of this material was increased to more than 192,857 tons. At this time probably 300 plants were engaged in the production of steel castings in the United States, including establishments making steel castings as an auxiliary product for application to their own equipment, and not for merchandising as a separate commodity.

Engineers, generally, are familiar to a considerable extent with the enormous ranges in physical properties obtainable from steel, but many do not realise that the steel foundry is producing metal comparable with the different grades of wrought-steel products. A study of heat-treatment went hand in hand with the additions of alloys, and the combined effects have resulted in available steel castings having tensile strengths from 22 to 89 tons per sq. in.

Refractories.—Bulletin No. 8, issued by John G. Stein & Company, Limited, of Bonnybridge, Scotland, is devoted to refractory cements. A very interesting table showing the characteristics of four main types is included.

Cast-Iron Scrap in Cupola Metal Mixtures.

By W. H. Bleeke.

It has been said, "The success of industry depends upon the utilisation of waste products." The principle expressed in these words apply with peculiar force to the scrap problem. The occurrence of cast-iron scrap arises out of two separate origins. They being in one case, production scrap, and in the other, replacement scrap. Under the former heading such material as runners, risers, feeding heads, etc., incorporated under the heading of "return" foundry scrap may be classed. The extent of this supply may be gauged by the fact that only from 50 to 65 per cent. of the metal melted find its way out of the foundry as finished castings. Replacement scrap includes that resulting from a natural process of the replacement of worn-out or obsolete machines and appliances. This division of the scrap-iron problem is prominent at the present time due to the extensive reorganisation and expensive rationalisation schemes now in progress resulting in large quantities of plant and machinery being scrapped.

Advantages of the Use of Scrap.

Every foundryman employs scrap metal as a part of his cupola iron charge, it varying from 10 to 100 per cent. according to the quality of metal it is necessary to produce and the scrap supply. Scrap metal is utilised in foundry metal mixtures for two reasons: these may be stated as being, (*a*) Economical, and (*b*) Metallurgical. Scrap metal is cheaper than pig-iron and thus its use bestows an economical advantage, in that it reduces the initial cost of the casting metal. Its metallurgical advantage is that it helps to adjust the pig-iron analysis to that desired in the final metal.

Scrap from Outside Sources.

In addition to the use of "return" foundry scrap, "foreign" scrap is also frequently employed. The term "foreign" is used to make clear the difference between the "return" scrap and that bought from outside sources. This may be of machinery, agricultural, railway or builders (radiator, stove plate and light castings) origin, each section being characterised by definite physical properties and chemical analysis. The suitability of "foreign" scrap for any particular metal mixture must be determined by such factors as the class of castings being produced, the degree of uniformity in composition, and the scrap size and thickness.

Considering the first factor, a practical scientific knowledge of cupola-melting principles is necessary in order to appreciate the force of the argument concerning the suitability of any "foreign" scrap for the production of a definite class of castings. An example of the application of these principles in this matter will be given. The cast iron most suitable for the vital parts of heavy internal-combustion engines, such as cylinders and cylinder heads, is one containing phosphorus content of 0.20 per cent. On paper, the mixing of a hematite pig-iron (low-phosphorus), radiator scrap (high-phosphorus) and steel scrap in correct proportions will give the desired phosphorus percentage. But it must be remembered that the mixing of metals containing a large variation of any or one element, melted under ordinary cupola conditions, is attendant with the trouble of irregularity in composition, which in turn affects the reliability of the casting. In analysis, *all* the components of the metal charge should be as near the final composition which is required as is possible and practical.

The second factor applies more particularly to the small jobbing foundry, where large tonnages of "foreign" scrap are not used. Here exists a danger that small tonnages of scrap will be purchased without any covering specification as to quality and origin, and thus the consignment may consist of all or some of the previously-enumerated sections mixed together. The use of such scrap introduces an uncontrollable variable into the metal practice, causing chaotic metal conditions with its responding evil in the manufacture of castings of unreliable and non-uniform properties. This difficulty of variable scrap is emphasised when the scrap dealer is in ignorance of the origin and character of the scrap, it merely being to him as "cast-iron scrap.

Concerning the third factor, the practical limits of the scrap size and thickness is a function of the cupola capacity. Large flat plates should be broken up, as they obstruct the passage of the blast and induce scaffolding. Excessively thin metal should be avoided, as oxidation troubles are liable to be encountered. The scrap charged should be as uniform in thickness and overall dimensions as possible.

General Considerations on the Melting of Scrap.

When extremely rusty or sandy scrap must be melted, a precautionary safeguard against the oxide passing into the metal is to add a little extra limestone immediately on top of the scrap when charged into the cupola. Burnt scrap, consisting of firebars, old malleable annealing pots, etc., should not be used at all—their place is in the blast furnace, as they are virtually specimens of iron ore. Where nickel-cast iron is made it is well to remember that the runners and risers, etc., off these castings also contain nickel, and this nickel scrap should be utilised in the furnace charges, thus reducing the amount of nickel to be added. It is the writer's experience that no loss of nickel occurs during the remelt in the cupola and allowances can be made for the full amount present.

From the viewpoint of uniformity and consistency, the foundry return scrap constitutes the most reliable in composition of all the metallic materials charged into the cupola. This item of the charge has been through the cupola at least once and all analysis irregularities have been smoothed out. Concerning the "foreign" scrap, there is a difficulty in obtaining a representative analysis of the consignment, which may have been collected from miscellaneous sources, but this can be minimised by definitely classifying the type of scrap required and refusing any substitutes offered or sent.

The amount of scrap employed in cupola charges varies considerably. For high-grade castings the scrap percentage should not exceed 50, the remainder being selected pig-iron. For ordinary castings the writer uses percentages as high as 70 with good and satisfactory results, but a note of warning is necessary. High scrap percentages are dangerous if the sulphur content of the final iron is not controlled. It is advisable under these conditions to employ a high-manganese pig-iron in the charge. This will take care of the sulphur and will act as a "cleanser" in the metal.

Conclusions.

Finally, it is necessary to bear in mind that the utilisation of poor or unsuitable scrap or the wrong use of good scrap will cause every conceivable kind of foundry trouble, but its proper and intelligent use will give material aid in lessening metal costs and improvement in the homogeneity of the metal.

Suez Canal Traffic. First Half, 1932.—During the first half of the current year shipping aggregating 14,042,000 net tons has passed through the Canal, or 1,650,000 tons less than in the first half of 1931, and 2,812,000 tons less than in the first half of 1929, the record year. The British flag showed a loss of 930,000 tons, the German flag one of 405,000 tons, the Dutch flag 232,000 tons, and the French flag 56,000 tons. The following four flags showed gains:—Italian, 54,000 tons; Danish, 43,000 tons; Russian, 35,000 tons; and the Japanese, 33,000 tons.

Catalogues Received.

Foundry Requisites.—Messrs. James Evans & Company, Limited, Britannia Works, Blackfriars, Manchester, have sent us a copy of their latest catalogue. It needs but a glance to see that this firm has a wealth of experience at their disposal. For instance, on the very first page, there is a statement that no less than 500 Rapid-type cupolas have been installed. Then, on the wire-brush section, the types shown are just those which years of actual manufacturing have proved to be most popular. Evans rightly stress, however, their willingness to manufacture to the buyers' designs. Quantity-production foundries should bear this in mind, as the mass cleaning of castings can often be effected more satisfactorily and cheaper by this method than any other. Radiators and builders' castings specially lend themselves to such treatment.

We suppose that Evans are best known for ladles, and they devote four pages to this item. Indeed, they publish a special comprehensive ladle list of nine pages showing the various types they supply. On page 3 we find a reference to bottom pouring steel ladles. Twenty years ago, more or less by accident, we personally co-operated in a design subsequently sold by Evans to many of the electric-steel foundries. In this special ladle list we also found reference to a totally-enclosed gear of a new design.

Two designs of pan mills are shown, the rollers of which can be adjustable as to height from the pan base, if desired, thus ensuring freedom from caking. They also have the advantage of a continued even pressure across the whole width of their face upon any depth of material in the pan. In connection with sand preparation—Evans, by the way, are actual manufacturers of riddles—they illustrate and describe a rotary hexagonal sieve; a stand sand sifter, and an electric gyrating riddle. Because people are now thinking in terms of overhead sand distribution, the utility of robust portable tools is sometimes overlooked. Properly used in a systematic manner they can constitute plant which will place the jobbing foundry on a plane comparable with the quantity-production establishments. Three types of moulding machines are listed, type A is a duplex machine, provided with two carriages; on these are mounted the pattern-plates or boxes. After filling with sand, each carriage in turn is mechanically drawn beneath a pneumatic cylinder; it is squeezed, vibrated and automatically stripped. Type B, which is jolt-squeeze, pattern-draw machine, has recently been re-designed and improved. The third machine is a hand-squeeze turnover machine. The last page of the catalogue is devoted to the foundry facings, made by the Glasgow Imperial Blacking Company, a subsidiary concern, and a wide range of products is hereon shown.

The metamorphosis which the foundry-equipment industry is now experiencing makes this catalogue especially interesting, as it discloses in no uncertain terms the ability of the issuing house to create for the foundry industry new machinery, tools and requisites to their own design and specification.

Weighing Apparatus. — Sectional Catalogue No. 28, issued by John White & Son, Auchtermuchty, Scotland, illustrates and describes an extremely wide range of weighing machines. We were especially attracted to a model, illustrated on page 23—a pillarless platform machine—made in three sizes, ranging from 7 to 15 cwts. In restricted places, such as are some cupola platforms, unfortunately, and where a constant charge is repeatedly weighed out, it certainly possesses some advantages. More than a dozen models of platforms are listed. It is interesting to note that this firm has been in the same family for more than 200 years.

Black-Heart Fractures in White-Heart Iron.

BIRMINGHAM DISCUSSION REVEALS CONFLICTING VIEWS.

When Mr. Murray's Paper, printed in our last issue, was thrown open to discussion, it was quickly shown that further experiment is still required to reconcile the views expressed. For instance, MR. F. J. COOK, Past-President of the Institute, who opened the discussion, and who said the lecturer had tackled the problem in a broad-minded way and come to some definite conclusions, remarked that he had presented a great many facts, but his own experience did not altogether bear out some of the deductions reached. A point had been made that the presence of black-heart in white-heart malleable was generally due to under-annealing. Now he had noticed many examples in such castings where the mechanical properties were quite good, and in which machining, elongation and ordinary mechanical tests were satisfactory. He himself had concluded that the vital factor was the balance of the manganese content. With too high a manganese content, black-heart centres, he found, had resulted. He considered that in cupola malleable, and also in air-furnace malleable iron, foundries did not value the question of manganese sufficiently. In the Evan's Paper at the Sheffield Convention it was shown that black-heart was governed to a large extent by this balance of manganese with sulphur in white-heart malleable. So far as he could trace it, if one exceeded a certain balance—which they did not often get in white-heart malleable, because it was generally low in manganese—black-heart centres were produced. However, with good annealing satisfactory results were obtained, although the colour was very bad from a white-heart point of view.

The CHAIRMAN (Mr. F. J. Pearce) congratulated Mr. Murray on his extensive experimental work, which, of course, was difficult under commercial conditions. The question of explaining picture frames was a baffling problem. But he would like to ask what was the real objection to black-heart fracture in white-heart castings, apart from any prejudice because a customer might not be used to it. How was it detrimental in service? So far from being bad in mechanical and other tests, his impression was that it was not so, and much white-heart malleable was in use containing black-heart fracture inside which was quite satisfactory. His experience on the matter of the balance of manganese and sulphur confirmed Mr. Cook's views. In illustration Mr. Pearce gave the results of two test-bars treated exactly the same, one showing a steely and the other a typical black-heart fracture. In this connection Mr. Pearce drew attention to the investigations on the ideal type of test-bar to show the properties of white-heart metal by Dr. Norbury, whose Paper had appeared in the JOURNAL* and was submitted as an exchange Paper for the Milan Foundry Congress. Explaining the microphotographs which accompanied that Paper, he said it was purely a fracture question which was discussed, and these problems could generally be expressed in terms of graphite distribution.

Incomplete Annealing.

MR. D. M. MADDOCK expressed dislike of black-heart fractures, especially when hot-straightened. After seven days' annealing, black-heart fractures were on occasion found as white-heart; but with further annealing it was possible to remove the black-heart fracture, which indicated that the annealing process was not complete in the first instance.

MR. HALL remarked that high-manganese producing black-heart was all very well so far as it went, but if they had an excess of sulphur and a higher manganese content the latter stabilised the graphite, and therefore no graphitic precipitation would be induced. He noticed that there was little change in the cooling test results from one to four days, and suggested that had the lecturer cooled down the bars from the second day and given them normal cooling, better results would probably have been secured. It seemed to him that the third, fourth and fifth days were more or less wasted, and thought grain-growth increased during the second, third and fourth days, causing deterioration in the metal. The results of the seventh, eighth and ninth days were due, he suggested, to the refining process. If in manufacturing black-heart iron, graphite was present in the early stages, the best plan was to make black-heart castings and not attempt white-heart. One of the reasons why black-heart picture frames were disliked was that there was invariably a strong band of pearlite just under the ferrite skin, and when the machine tool hit it the metal separated straight away.

Normalising after Annealing.

MR. S. C. WARLEY asked could it be put forward as a proposition for improving malleable castings to normalise them after being annealed, because when cooled slowly the grain was refined. Mr. F. K. Neath also drew attention to the German practice of high manganese in white-heart malleable, remarking that 0.6 was sought in pig-iron, and that a dark fracture appeared in a good deal of this German white-heart after annealing. Still, they did not seem to meet with any other difficulties, although he had not heard of it in connection with brazing. It had been stated abroad that German castings were better than English or American, he added.

AUTHOR'S REPLY.

MR. MURRAY, in reply, agreed with most of Mr. Cook's remarks regarding manganese balance in connection with annealing. Whether the manganese was properly balanced or not, however, he had sometimes found that black-heart fractures would occur exactly in the same way as he had shown. Still, he had evidence to show that, with a proper balance of manganese with sulphur, there was a better precipitation of the carbon. Touching on the points raised by Mr. Pearce, he said he had experimental proof that black-heart fractures were due entirely to deposited carbon. If malleable castings with true black-heart fractures had to be subjected to heat-treatment, such as brazing or hot straightening, the deposited carbon would come into solution, which tended to make the castings brittle. He had heard of castings being brazed to motor cycles and left on the floor; and next morning, when ready for following operations, they simply parted on being taken up—he referred to frame tubes.

Research Impressions.

He suggested that white-heart malleable was looked upon with suspicion, and would like the British Cast Iron Research Association to alter its practice. For it appeared that when white-heart malleable work was to be a subject of research the melt was in the cupola, whereas for other metals the air or the electric furnace was used. Thus, they had the worst conditions on the one hand, and the finest on the other. When researches were made, and when two metals such as white-heart and black-heart were being tested, they should be melted in the same way in order to secure a true comparison. White-heart malleable cast iron, if scientifically supervised, was equal to mild steel, and in many cases superior to it. The trend of the industry was towards control; foundries which held to rule-of-thumb methods, or what their grandfathers did, were hopeless, and these were conditions which made people say, "Malleable won't do." He considered that white-heart malleable was not even faintly understood in many quarters. It was capable of doing far more work than many metallurgists thought. It could be case-hardened; black-heart could not. It could be heat-treated, quenched in oil, and tempered the same as steel; black-heart could not, and in many things it was superior to black-heart. They never heard of a black-heart foundry conducted otherwise than on scientific lines or control, but there were only too few white-heart foundries which had any serious control. The centipedic fracture which had been referred to was evidence of a badly-annealed malleable casting, and was probably subject to quick cooling. The lecturer then mentioned in connection with hot straightening and consequent brittleness that of two castings from the same pot, one was white-heart and the other black-heart. This could be put down to temperature conditions in the can—one side hot, and consequent under-annealing on the other side. If people were buying black-heart for white-heart, it was possible that the material might be required to be heat-treated, which would ruin it. Therefore, he suggested that malleable with black-heart fracture might be termed black-heart. A high-carbon zone of pearlite in such metal would be liable to "jump off" and cause breakages. In regard to Mr. S. C. Warley's point, slow cooling would not refine white-heart. The grain might be large, but if it was taken back and normalised, when it passed the Acl point, the structure recrystallised, and that refined the structure. He himself made it as a serious proposition that white-heart malleable should be normalised; this gave it a chance. The Brinell test should also be incorporated in malleable tests, because it would show whether zones of pearlite were present in black-heart fracture as well as in white-heart. He had not found German malleable better than English, and did not consider it was generally so, although it might be better than the malleable produced without control, which was the chief fault in the industry in this country.

* "Mechanical Properties of Malleable Iron on Various-sized Test-Bars." FOUNDRY TRADE JOURNAL. September 17. 1931 page 175 and October 1, 1931, page 205.

American Symposium of Cast Iron.

During the next twelve months one of the most active groups of the American Society for Testing Materials Committee A-3 on Cast Iron will be that one which is co-operating with representatives of the American Foundrymen's Association to prepare a symposium on cast iron. This is to be held during the 1933 Annual Meeting of the Society in Chicago. The two sponsor societies have already held symposiums on malleable iron and on steel castings, so that the forthcoming one is the third in the series. The purpose of these is to compile and publish critical authoritative data on the important technical aspects of the materials.

For two years the committee has been investigating the impact testing of cast iron in one of the most comprehensive research projects ever attempted in this field. The work is substantially completed and the final report will be made in the near future. Consideration is being given to the heat-treatment of grey cast iron, which is being rapidly developed and widely used. At the recent meeting of this committee the following officers were re-elected for the ensuing term of two years:—*Chairman*: Mr. Hyman Bornstein, Director of Laboratories, Deere & Company; *Vice-Chairman*: Mr. A. L. Boegehold, Metallurgist, General Motors Research Laboratories; *Secretary*: Mr. W. H. Rother, Metallurgist, Buffalo Foundry & Machine Company.

THE TENDER of Messrs. Sir W. G. Armstrong Whitworth & Company, Limited, Newcastle-upon-Tyne, has been selected by the Naval Engineering Commission at Brazil for the building of a new training ship to cost £314,500. Tenders were submitted by 16 firms. The sanction of the President of the republic has yet to be obtained.

A New Oil-Fired Furnace for High-Test Cast Iron.

By F. Brocke (Lauchhammer, Germany).

The progressive foundryman is keenly alive to the necessity for producing grey-iron and steel castings of definitely superior quality to those which have been marketed in the past. Many methods have been developed to meet that demand, including improved cupola practice, steel-scrap additions to iron charges, alloy additions and the use of various types of melting and refining furnaces. The melting of large percentages of steel scrap or low-carbon iron in the

Fig. 1.—Unetched Micro of Schury Furnace Iron of T.C. 3.05, Si 1.62, Mn 0.60 and P 0.06.

cupola for the production of high-grade iron and the pouring of the liquid metal into the moulds so as to obtain such material, has occupied the minds of many metallurgists. The short freezing range of low-carbon iron will not allow one to use dullish metal, and, moreover, moulds must be poured as hot as possible in order to avoid

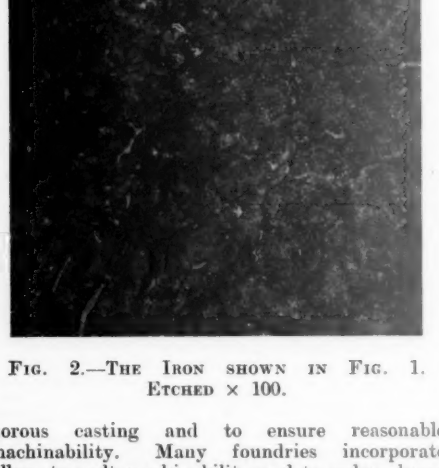

Fig. 2.—The Iron shown in Fig. 1. Etched × 100.

porous casting and to ensure reasonable machinability. Many foundries incorporate alloys to melt machinability and to reduce losses caused by hard spots. It is thought, however, that for many foundries manufacturing high-quality iron in the cupola the use of alloys does serve a useful purpose, but their high cost may in many cases be offset by ultimate economies. A simple and economical way of producing grey iron of high mechanical strength and good machinability is through the use of ancillary refining process. The molten iron is superheated in the cupola and is refined by a duplexing process in specially-designed open-hearth furnaces. Typical amongst these is the Schury oil-fired open-hearth furnace, the construction of which is covered by patent. This furnace has been specially designed to produce grey iron, malleable iron and steel of high-grade quality, and its success is testified by the fact that there are now about 20 installations in operation in the German foundry industry. The furnace may have either a stationary or tilting hearth and is provided with two air superheaters which are sunk beneath the furnace. The superheaters are so designed that they provide red-hot secondary air for perfect combustion. On each side of the furnace is a burner of efficient construction and design. After atomisation the hot secondary air is intimately mixed and combusts in the furnace at a temperature of about 1,925 deg. C. This high temperature and associated with a neutral atmosphere results in a product of high-grade quality accompanied by very small metallic losses. The roof of the furnace is removable and the air cooling of the

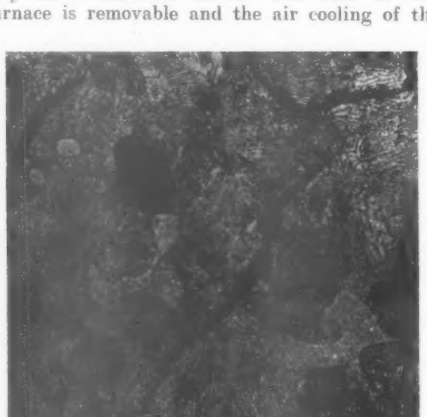

Fig. 3.—The Iron shown in Fig. 1, but etched × 500.

lining is a still further characteristic of the furnace.

After combustion the flame communicates the residual heat to the superheaters, which are placed on every side of the foundations of the furnace. A chimney is used to exhaust finally the products of combustion. For original ignition a torch is used in lighting the mixture of fuel and air. The burner is then swung into position and the firing equipment then started off. The furnace is charged from a ladle when it is operating duplex, and the cupola-melted iron is discharged into the launder of the furnace. After refining it is cast into the moulds in the usual manner. After tapping the furnace the slag is drained off, the tap hole is made up with ground ganister and the hearth prepared for the next charge. The necessary labour is supplied by one melter with an occasional labourer. When working duplex, however, the use of a labourer is not necessary.

Normally, liquid grey iron is refined in one hour, and the oil consumption is 4 per cent. of the rate of the charge. An excellent homogeneous metal is produced, having an average tensile strength of 10 tons per sq. in. and a Brinell hardness of from 180 to 220.

The results obtained from a series of tests made on standard bars of refined grey iron by this furnace show the iron to be of about 20 tons tensile. The micrographs shown, Figs. 1 to 3, were taken from standard test-bars. The graphite flakes in Fig. 1 are of small and uniform distribution, whilst the pearlitic structure shown in Fig. 3 is typical of high-grade refined iron. The charge utilised was made from 40 per cent. pig-iron, 25 per cent. of high-quality foundry returns, 25 per cent. of ordinary scrap and 10 per cent. of steel. The total of the iron oxide, alumina and silica in the limestone is specified not to exceed 3 per cent. When melting heavy percentages of scrap iron, soda ash is successfully utilised to reduce sulphur content. The resulting slag must be carefully removed in order to prevent sulphur returning to the bar. The control over the composition which this furnace allows is extremely good. Both acid and basic linings have been used in the construction of these furnaces, and over 350 heats is considered as an average life when starting from cold each day. The furnace has been used with success for the manufacture of castings for the chemical industry, especially boilers weighing from 10 to 12 tons. The furnace has also been used for the production of steel castings which are characterised by their freedom from any tendency to pull. No difficulty is experienced when small castings are hand-shanked. Starting from cold, the fuel consumption amounts to between 17 and 19 per cent., as against 10 per cent. when melting grey or malleable iron. Such charges occupy 7 hrs. for the first heat and about 4½ for those which follow. The furnace is flexible and can be operated continuously or intermittently with equal success.

A Permanent Exhibition of Castings.

The Building Centre opened up last Monday a permanent exhibition of material of interest to the building industry at 158, New Bond Street, London, W.1. There are, we were told, close on a thousand exhibitors, the majority of which had taken space for three years. Amongst these are a number of founders, some showing as founders and others as electrical or other sorts of engineers. Is there a real demand for such a permanent exhibition? Will it tend to become stereotyped and orthodox with the passing of time? These questions are of paramount importance, because a second similar effort for trade in general is projected for Gamage's late premises at the Marble Arch. Whilst we reserve judgment for the moment, we can say of the present exhibition that the site chosen could not very well be improved upon, as Bond Street does attract people with a buying capacity. Moreover, at the moment, it is new and fascinatingly interesting for the foundryman. One thing above all others is outstanding, and that is the definite superiority in colour and finish of dyed aluminium alloys over those fabricated from gum and resinous products. The doors, made by Gibbons, of Wolverhampton, incorporate blue panels of a perfection we have rarely encountered in decorative art. The British Aluminium Company, too, show some coloured castings, which we presume have also been dyed, and these, too, are of excellent appearance. Walter Macfarlane, of Glasgow, have some very fine castings incorporated in their bannister work, but this is somewhat spoilt by the appearance of the mahogany rail and the treads. They do not do justice to the excellence of the castings shown.

It will be realised that as the exhibition is contained on three floors, some of the exhibits are almost ridiculously small, for instance that of a bell foundry being contained in a small sized locker.

The first four of a consignment of eight Diesel engines and generators from Zurich have arrived at Newcastle to be fitted into British rail cars for use in Buenos Aires.

Improved Equipment for Die Castings.*

By WILLIAM M. LESTER (Lester Die & Machine Company, Cleveland).

Die-casting manufacturers have made a determined effort in the past to better their product and, through mechanical improvements in casting equipment, in addition to the improved alloys used, have been able to meet competition from the pressed steel, forging and cast-iron industries.

Two Types of Die-Casting Equipment.

The actual casting methods employed in the art have changed but slightly during the past decade. These can be classed in two groups. The first method employs the plunger mechanism, where a positive mechanical pressure on the casting material is secured in a pumping mechanism submerged in a bath of the material. The second method depends upon an air gooseneck device, where pneumatic pressure forces the alloy from a closed chamber into the mould. Through changes in equipment much laborious manual effort was eliminated, but the quality of resultant castings was not improved to any great extent by this factor.

The problems to be confronted were manifold. In the plunger type of pumping mechanism the main difficulty encountered was in securing a definite fit between the plunger and its cylinder which would endure. In use a plunger, having the exact working clearance to build up and hold a suitable casting pressure, would, following a few hours' use, lose its ability forcefully to propel the molten material into the mould. This short life of the plunger, evidently caused by the high working temperature and pressure, together with the washing action of the fluid alloy, could be prolonged by close temperature control. The result, however, was still far from satisfactory.

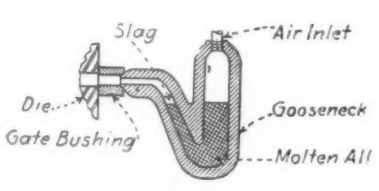

Fig. 1

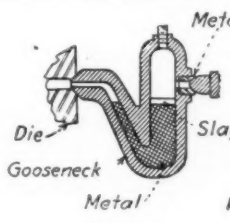

Fig. 2

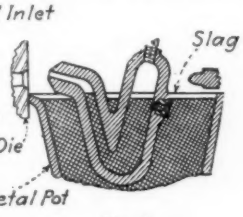

Fig. 3

Difficulties Encountered with Air Gooseneck Type.

A more defective method has been resorted to for the die casting of aluminium-base alloys. This has been carried out in an air gooseneck type of injecting mechanism, the faults of which are manifold. A comparatively higher working temperature must be used because of limited pressures. This resulted in a greater iron contamination in the resulting castings and a shortening in the life of the parts subjected to these adverse conditions.

The release of high-pressure air with terrific impact upon the surface of the molten material, in its enclosed chamber, imparted a great velocity to the metal entering the cavity of the die. So little time is required for the filling of the die cavity that the air present therein, before the injection of metal, has no time to escape and is subsequently trapped in the casting in the form of blow holes and surface air swirls.

Another difficulty encountered in air gooseknecks is quite common to all the various types which depend upon filling the gooseneck from the front or discharge nozzle. Slag, ever present on the surface of the metal in the holding pot into which the gooseneck is immersed, will seek the position shown in Fig. 1.

In the air gooseneck type of die-casting machine, shown here, the nozzle is dipped down into a bath to receive the metal. When the gooseneck is dipped back the slag that has entered with the metal remains near the top of the front chamber. Sometimes metal adheres to the nozzle preventing it from making close contact with the bushing connecting the gooseneck with the die. As a result metal flies out at that point when it is being forced into the die. Trouble of this sort is experienced mostly with aluminium base castings.

Upon the release of the casting air it is quite apparent that the slag is the first to enter the die. This slag contamination can be minimised by either the use of sufficient overflows in the die to trap the slag or the frequent skimming of the molten metal in the holding pot. The first solution brings in the counter element of an increased air space in the die cavity and a corresponding detrimental air condition. The second solution proves to be more effective but less desirable where production alone is the governing factor.

Developments during the past year in die-casting equipment promise to eliminate many of the above-mentioned evils. The plunger type of casting machine provides a mechanism which satisfactorily performs as long as six months without replacement of either the plunger or its cylinder. The pumping action, carried on in the adverse conditions outlined above, creates a certain amount of wear in the working parts which is automatically taken care of by their features of design

Allowance for the slag condition in the air gooseneck mechanism has been made in the device shown in Figs. 2 and 3. Fig. 2 shows the gooseneck in casting position. When the casting air is released it is quite apparent that the slag will not enter the die unless the size of the cavity in the die taxes the extreme capacity of the gooseneck. Fig. 3 shows the gooseneck in charging position. In this design the metal inlet is in the back; and the front, or nozzle, does not go below the surface of the metal. The slag remains in the back chamber. The metal inlet is shut off automatically, and when the air is applied the slag is forced downward but never enters the front of the gooseneck, every day or two the accumulation of slag is blown out by applying the air pressure on the back of the gooseneck. If any of the metal hardens at the inlet so that valve does not seat tightly, the only effect is that air escapes through the valve, which is not troublesome as the escape of metal at the nozzle.

Fig. 2 shows the gooseneck coming in actual contact with the die rather than with the intermediate bushing shown in Fig. 1. This development is advantageous in the following manner:—First, it has meant a decrease of at least 50 per cent. in the size of the sprue, which constitutes the largest part of the gate or surplus to the casting. This decrease has brought about a corresponding change in the amount of air which must be removed from the die to permit correct casting performance. Second, an increase in casting production is secured by elimination of much of the metal to be solidified. Third, production is also increased by this shortening of the sprue which now permits a corresponding shortening of the die opening.

Tests have proved that this mechanism produces a much superior grade of casting, not only with respect to solidity, but also surface finish.

Considerable research is still in force, not only along lines above detailed, but also in respect to effect of throttling the velocity of the metal entering the die in the air gooseneck device.

* From the "Iron Age."

High-Test Cast Iron.

Mr. Frank Hudson (Kilmarnock), in a written contribution to the discussion on Mr. MacPherran's Paper on "High-Test Cast Iron in the United States," said he was particularly interested in what had been said, as it was so essentially practical and constituted such an excellent advertisement for the ironfounder. As sellers of castings to the engineering industry, the more we can convince engineers of the great improvements being made in our trade then the greater are potential sales. Accordingly he felt that British foundrymen should be deeply grateful for the able way in which Mr. MacPherran has outlined the progress made by our friends in the United States, as at the present time the comparison is particularly valuable in view of recent developments in this country, making particular reference to the work of Mr. J. E. Hurst in connection with the heat-treatment of cast iron, and with the developments at Sir W. G. Armstrong Whitworth's Close Works foundry employing pulverised-coal-fired rotary furnaces for the direct production of high-test cast iron.

The economic conditions prevalent in this country do not lead to the use of electric furnaces for the production of iron castings, and personally he did not see any future hope that their employment was likely to arise. Accordingly the latter part of Mr. MacPherran's Paper treating on the production of high-test cast iron from the cupola is most likely to be of direct interest. One was apt to be misled, however, in assuming that the use of high steel-scrap percentages in the cupola charge will effect a cost reduction in price of raw materials used. It should be remembered that if great care is not taken in properly controlling the amount of additional alloys, such as ferro-silicon, ferro-manganese and nickel, any advantage in cost will be lost. Perhaps it might be contended that the aim was not to reduce cost so much as to increase quality, but surely the true aim in all business principles was to produce the highest quality at the lowest price. It is of interest to compare the cost of the mixture used by Mr. MacPherran as given on page 3, column 3, of the Preprint against ordinary practice:—

	Per ton. £	s.	d.
Cost of raw materials using Mr. MacPherran's high-steel 1 per cent. nickel mix	5	1	7½
Cost of raw materials as above without nickel addition	3	0	0
Cost of average cupola mixture using, say, 50 per cent. pig, 50 per cent scrap	2	18	0

From this it will be noted that the high steel-scrap mixture is 2s. per ton dearer than an ordinary mixture composed of 50 per cent. pig. More economical results could be obtained in many foundries by adopting a 1.5 per cent. silicon mixture where casting section permits. At the present time his firm were experimenting on a mixture made up as follows:—3 per cent. ferro-silicon; ¾ per cent. ferro-manganese; 13 per cent. cast-iron scrap, and 82¼ per cent. steel scrap. This should produce results equal to those obtainable by Mr. MacPherran, and its cost is only £2 15s. 3d. per ton, or 2s. 9d. cheaper than the ordinary mixture given above. Of all the elements affecting the successful economic cupola melting of high steel-scrap charges, it is thought manganese warrants the most attention to obtain success.

This Week's News in Brief.

Trade Talk.

MESSRS. M'KAY & BAXTER, LIMITED, Paisley, have secured an order to supply the propelling machinery for a vessel being built in India.

THE BARROW HEMATITE STEEL COMPANY, LIMITED, has announced that the steelworks, which have been idle for some weeks, reopened on September 6.

AFTER BEING CLOSED for many months the drum-making works of the International Paint & Compositions Company, Limited, at Felling-on-Tyne, are being reopened.

THE CLEVELAND STEEL CASEMENTS COMPANY, LIMITED, Middlesbrough, is hoping to start additional workmen soon, following the installation of new plant. The firm was formed only two months ago.

THE FORD MOTOR COMPANY, LIMITED, have extended an invitation to the London Branch of the Institute of British Foundrymen to visit their works at Dagenham on Thursday afternoon, September 29, 1932.

MESSRS. CHARLES HILL & SONS, LIMITED, Albion Dockyard, Bristol, have received a contract for the building of two hoppers for the Great Western Railway, to be used in connection with dredging operations at Cardiff docks.

MESSRS. VICKERS-ARMSTRONGS, LIMITED, Barrow-in-Furness, have launched the 22,000-ton turbo-electric ship "Queen of Bermuda," built for the Furness Withy line to replace the "Bermuda," which was destroyed by fire in Belfast Harbour last year.

MESSRS. WILLIAM BEARDMORE & COMPANY, LIMITED, Dalmuir, have received an order from the Admiralty to supply the machinery for the H.M.S. "Amphion," the hull of which is to be built at Portsmouth Dockyard under the delayed 1931 programme. The castings and other parts will be made at Parkhead works, and at Dalmuir employment will be found for a large number of men for about two years.

WORK FOR A Glasgow shipyard and a Greenock engineering shop will be provided by an order which Messrs. Burns Philip & Company, of Sydney, have placed with Messrs. Barclay Curle & Company, Limited, Whiteinch, Glasgow, to build a passenger and cargo steamer for service on the Australia and Pacific Islands service. The vessel will be similar to the "Macdhui," which Messrs. Barclay Curle built for the same owners last year, which had a deadweight of 3,200 tons, was 340 ft. long, 51 ft. broad and 31½ ft. deep. She will be fitted with Diesel engines of the Burmeister-Wain type constructed by Messrs. J. G. Kincaid & Company, Limited, Greenock. Like her predecessors, the vessel will be equipped to meet the special requirements of the Australian trade and cargo handling.

THE ADMIRALTY HAS AWARDED contracts for the cruisers of the delayed 1931 programme to the following firms: Vickers-Armstrongs, Limited, Barrow-in-Furness, hull and machinery of H.M.S. "Ajax"; Wm. Beardmore & Company, Limited, Dalmuir, machinery for H.M.S. "Amphion" (hull to be built at Portsmouth); Parsons Marine Steam Turbine Company, Limited, Wallsend-on-Tyne, machinery for H.M.S. "Arethusa" (hull to be built at Chatham). The "Ajax" and "Amphion" belong to the Leander Class, of 7,000 tons. The "Arethusa" is the first cruiser of a new type, displacing 5,450 tons. Further contracts for eight destroyers, two submarines and two sloops are to be placed with private firms in the course of the next few weeks.

PRESIDING AT THE ANNUAL MEETING of Messrs. Braithwaite & Company, Engineers, Limited, MR. J. H. HUMPHRYES (the chairman) said that after charging depreciation and bank interest, the net result of the year's trading was a loss of £27,586. The directors had exercised close and constant control over all expenditure, and had effected economy in working by concentrating on "press" work at Newport and "structural" work at West Bromwich. The year under review benefited only partially from the economies effected. Economies of themselves could not, however, compensate for the difficult trading conditions, and the directors were therefore paying constant attention to the development of the company's specialities. The company was well placed to take advantage of the turn of the tide and a resumption of overseas buying.

THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED, RUGBY, has just received an order from the Associated Electrical Industries (India), Limited, for a large synchronous motor to drive a continuous sheet-bar and billet rolling mill at the Jamshedpur Works, India, of the Tata Iron & Steel Company. The motor, which is of the totally-enclosed type with closed-circuit air cooling, will be rated at 7,500 h.p., 6,300/3,150 volts, 50 cycles, 0.8 leading power factor, 93.8 r.p.m., and will be able to take peak loads of 18,750 h.p. The B.T.H. Company is also supplying the automatic control gear for starting, reversing and emergency stopping. The motor has a diameter of 26 ft., with a shaft 2 ft. diameter. Within 24 hours of the order being received the stator plates were being flame-cut in the B.T.H. Rugby works as a preliminary to the building up of the frame.

MR. FREDERICK W. FIRTH, in moving the adoption of the report of the directors of the Brightside Foundry & Engineering Company, Limited, at the annual meeting recently referred to two matters which were likely to help the firm materially in future. One was the introduction of a furnace which was almost smokeless, and the other was the benefit of tariffs. Mr. Firth spoke of the economies effected in consequence of the difficult trade conditions, and said that though they were now better off on the rolling mill, engineering side prices were such that it was impossible to obtain even a small margin of profit. Something might be attempted to stop the apparently never-ending price-cutting which left all without profit. In connection with the heating and ventilating department they had put on the market a patent furnace for steam boilers which was as nearly smokeless as was practically possible. It was just the kind of work they wanted for their shops, and several furnaces had been installed with complete satisfaction. He was convinced that the preferential tariffs would ultimately help. They had already made some progress owing to tariffs. Recently the company made arrangements to co-operate with a well-known Continental firm in manufacturing cold-rolling mill machinery in this country. That type of machine had only been manufactured here on a small scale, but he was convinced that it had a wide application in the ferrous and non-ferrous industries.

Personal.

SIR HENRY FOWLER is to represent the Institute of Metals and Mr. J. G. PEARCE the Iron and Steel Institute at the International Foundry Convention to be held in Paris next week.

MR. C. J. WALSH, who has been elected Senior Warden of the Cutlers' Company, is managing director of Messrs. Ibbotson Bros. & Company, Limited, the Sheffield steel manufacturers.

MR. SIDNEY HALL received a presentation last week at the Atlas Works of Messrs. Thos. Firth & John Brown, Limited, Sheffield, on the occasion of his retirement after nearly 49 years' service in the commercial drawing office.

LIEUT.-COLONEL A. N. LEE, who has been Senior Warden during the past year, was elected Master Cutler for the ensuing year, at a general meeting of the Cutlers' Company of Sheffield. Colonel Lee is a director of Messrs. Walker & Hall, Limited, cutlery and metal manufacturers, Sheffield.

MR. R. K. JOPSON, the Commercial Secretary to the British Embassy at Buenos Aires, is now in this country on an official visit. Mr. Jopson will be available at the offices of the Department of Overseas Trade during the period September 19-24 for the purpose of interviewing manufacturers and merchants interested in the export of United Kingdom goods to the Argentine Republic. At a later date Mr. Jopson will visit a number of industrial centres in the provinces.

Wills.

AINSWORTH, P. C., of Gosforth, mill manager to the Consett Iron Company, Limited £12,891

LAWSON, THOMAS, founder and head of the Scottish Foundry Company, Bankside, London, S.E. £47,169

MERTHYR, LORD, of Hean Castle, Saundersfoot, Pembrokeshire, chairman of the Melingriffith Company, Limited, Cardiff £518,563

Company Reports.

John Bolding & Sons, Limited.—No interim dividend on the ordinary shares.

Thomas Robinson & Son, Limited.—No interim dividend is to be paid on the ordinary shares.

Wallsend Slipway & Engineering Company, Limited.—Interim dividend of 2½ per cent., less tax, on the ordinary shares.

North British Locomotive Company, Limited.—The directors have decided to make no interim payment on the preference shares.

R. & W. Hawthorn Leslie & Company, Limited.—Dividend of 6 per cent. for the year ended June 30.

J. Grayson Lowood & Company, Limited.—Loss of £398, reducing the credit balance brought in to £680.

Ibbotson Bros. & Company, Limited.—Loss for year ended June 30, 1932, £14,226; brought in, £69,009; carried forward, £54,783.

Brightside Foundry & Engineering Company, Limited.—Loss for year ended June 30, 1932, £5,903; brought in, £12,992; carried forward, £7,089.

Walter Scott, Limited.—Profit of £1,208, reducing the debit balance brought in to £186,294. Interest on the 4 per cent. debenture stock for year, £12,000, makes the deficit £198,294.

Coghlan Steel & Iron Company, Limited.—Profit, after providing for depreciation, etc., £159; brought in, £285; transferred from reserve, £2,000; preference dividend, £2,027; carried forward, £416.

Barrow Hæmatite Steel Company, Limited.—The profit and loss account shows a debit balance of £21,605, which, added to the debit balance of £32,460 brought in, makes the total at debit of profit and loss account at December 31 last £54,065.

Charles Roberts & Company, Limited.—The directors have decided, in pursuance of their policy of conserving resources, to withhold payment of the preference dividend for the half-year ended June 30, which ordinarily would be paid on September 1.

Contracts Open.

Cairo, September 10.—Cast-iron spigot and socket pipes, cast-iron distribution hydrants, valves, flanges, etc., for the Egyptian Ministry of the Interior, Local Municipalities and Commissions Section. The Department of Overseas Trade. (Reference G.X. 11,742.)

Cairo, September 26.—Cast-iron pipes and accessories, for the Egyptian Ministry of Public Works. The Department of Overseas Trade. (Reference G.X. 11,743.)

Cairo, September 24.—Cast-iron and wrought-iron pipes, accessories, etc., for the Ministry of Public Works, Mechanical and Electrical Department. The Department of Overseas Trade. (Reference G. 11,771.)

Holbeach, September 16.—43 miles of 5-in., 4-in. and 3-in. cast-iron pipes, with valves, etc., for the East Elloe Rural District Council. Sir Alex. Binnie, Son & Deacon, engineers, Artillery House, Artillery Row, Westminster, S.W.1. (Fee £10, returnable.)

London, E.C., September 13.—Cast-iron and spun-iron socket and spigot straight pipes, for the Metropolitan Water Board. The Chief Engineer, Offices of the Board (Room 155), 173, Rosebery Avenue, E.C.1.

Shilbottle, September 10.—2,500 yds. of 4-in. standard British cast-iron socket pipes and fittings, for the Alnwick Rural District Council. The Clerk to the Council, 28, Bondgate Within, Alnwick.

Simla, October 4.—Four 3-ton level luffing electric quay cranes, for the Indian Stores Department. The Department of Overseas Trade. (Reference A.X. 11,447.)

Obituary.

MR. EDWARD TAILBY, founder of the Stonehouse Works Company, West Bromwich, has died at the age of 94. Mr. Tailby's son, Mr. Norman Tailby, the present proprietor, took over the business soon after the war.

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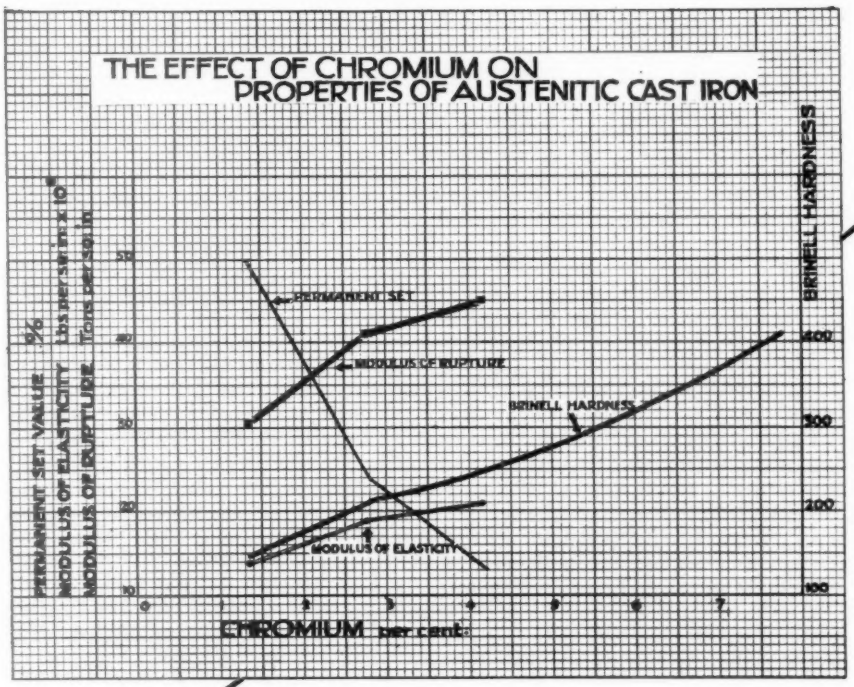
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MODULUS OF RUPTURE Tons per sq. in.
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PERMANENT SET
MODULUS OF RUPTURE
BRINELL HARDNESS
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Raw Material Markets.

There has been a considerable revival of confidence in the iron and steel markets, and prospects for the winter are brighter than was expected. More business is reported in pig-iron and, to a lesser extent, in finished steel, although orders as yet are mostly on the small side. If any strong buying movement develops, it should gain considerable impetus from the general lowness of consumers' stocks. The outlook on the export side has also improved, there being an increased volume of inquiry from several overseas markets, probably stimulated by the slightly increased prices now prevailing on the Continent.

Pig-Iron.

MIDDLESBROUGH.—Business has taken a decided turn for the better during the last week. Not only has the number of small orders booked increased, but consumers are also more disposed to enter into pig-iron contracts. Stocks at the moment are sufficient to satisfy the demand, but should there be any further improvement, additional blast furnaces will be restarted. The Tees shipments of pig-iron reached 7,296 tons in August, as against 6,388 tons in July, a very satisfactory figure in view of the holiday interruptions last month. Price concessions for Cleveland iron are still confined to Scotland, the quotations to other consumers, f.o.t. or f.o.b., being :—No. 1 Cleveland foundry iron, 61s.; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s. per ton.

The East Coast hematite market is also showing a stronger tone, and buyers are now coming forward more readily with contracts. Quotations are fairly firm at 60s. per ton for mixed numbers and 60s. 6d. for No. 1 grade. It is also reported that there is a better inquiry for West Coast hematite, and the situation would be fairly satisfactory were it not for the irregular operation of the Barrow and Workington steel mills. Bessemer mixed numbers are maintained at 66s. per ton at works.

LANCASHIRE.—There is only a poor demand from the general foundries in this area, there still being a glut of cheap scrap material. Little new forward business of any consequence has been placed. The strike in the textile industry is, of course, an unsettling factor. Prices are steady, with Derbyshire and Staffordshire No. 3 quoted for delivery to works in the Manchester area at 67s. per ton, North-East Coast at about the same figure, Northants at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at from 84s. 6d., and West Coast hematite at about 81s. Indian brands of iron are quoted at from 67s. to 75s. per ton, according to grade.

MIDLANDS.—Requisitions for September delivery show a considerable improvement over the preceding two months, and there are prospects of a reduction in the makers' stocks, which have recently been steadily increasing. Conditions remain irregular in the various consuming industries. The heavy engineering foundries are still short of work, but there has been more expansion in connection with light castings. Prices of pig-iron were recently reconsidered at a meeting of the producers, but no changes were made, Northants No. 3 being at 62s. 6d., and Derbyshire, North Staffs and Lincolnshire No. 3 at 66s., including delivery to Birmingham and Black Country stations. Cleveland No. 3 is still available at 66s. per ton, delivered. Continental foundry iron remains uncompetitive in this area.

SCOTLAND.—Conditions remain very difficult in the iron and steel trades in this district. Not since the year 1860 has Scottish shipbuilding been at such a low level as at present, activity being correspondingly reduced at many of the foundries. No. 3 Scottish foundry iron is still at the official minimum of 69s. 6d. per ton at furnaces, with 2s. 6d. extra for No. 1. There is a very poor demand for English iron, and No. 3 Middlesbrough is still quoted at 55s. 6d. at Falkirk, with Midland irons obtainable at about 1s. 6d. per ton less.

Coke.

The foundry-coke market remains largely stationary. Little forward interest is displayed, although consumers generally cover their winter requirements at about this period. Best Durham foundry coke delivered Birmingham is quoted at about 37s. 6d. for prompt or deferred despatch, with cheaper grades at 35s. Welsh foundry coke varies from 30s. to 45s. per ton, according to analysis, delivered Birmingham.

Steel.

There are indications that the finished-steel market is beginning to recover from its recent inactivity. As yet, buying is on a small scale, but an encouraging number of forward inquiries is in circulation. Semi-finished steel is also a stronger market, and the firmer tone of Continental prices has placed the British works in a slightly better position. It seems that business in this section has at last recovered from its recent low levels.

Scrap.

In the Cleveland area, the demand for scrap iron is weakened by the slackness of work at many of the foundries, but, nevertheless, several large contracts have been placed, and the tone of the market is decidedly more optimistic. Heavy cast iron is quoted at 35s. per ton, delivered, good machinery quality at 36s. and light castings at 30s. The Midlands scrap-iron market has, however, shown little improvement, few consumers now being in the position to enter into fresh contracts. Heavy machinery metal is offered at 45s., and clean light metal at 35s., delivered. Good cast-iron textile scrap is being offered at 40s. per ton, delivered. Business remains stagnant in Scotland. Machinery cast-iron scrap can be had at about 43s. to 44s., and ordinary cast iron at 39s. Light cast-iron scrap is unchanged at 34s. to 35s. In South Wales, heavy cast iron remains firm at 42s. 6d. to 43s. 6d., while good cast-iron machinery scrap has been slightly more active at 45s. to 47s. 6d. per ton, delivered.

Metals.

Copper.—The price of this metal continues to mount, in expectation of the imposition by the Government of the import duty of 2d. per lb. recommended at the Ottawa Conference. The tone of the market remains very strong, in spite of continual profit-taking, but it is thought that the peak of the upward movement has about been reached. Trade demand on the Continent has strengthened in recent weeks, while an increasing volume of inquiries is being received from home consumers, a number of whom have had to buy at recent rates owing to lack of covering stocks.

Closing quotations :—

Cash.—Thursday, £35 5s. to £35 6s. 3d.; Friday, £35 13s. 9d. to £35 15s.; Monday, £37 7s. 6d. to £37 8s. 9d.; Tuesday, £37 17s. 6d. to £38; Wednesday, £37 13s. 9d. to £37 16s. 3d.

Three Months.—Thursday, £35 5s. to £35 6s. 3d.; Friday, £35 16s. 3d. to £35 17s. 6d.; Monday, £37 8s. 9d. to £37 10s.; Tuesday, £38 to £38 2s. 6d.; Wednesday, £37 13s. 9d. to £37 16s. 3d.

Tin.—The most satisfactory feature of the past week's trading has been the increased sales made to consumers in South Wales and on the Continent. American purchases are also reported to have been stronger than for some time past. Since January, the total visible supplies have only decreased by 2,516 tons in spite of the "export holiday" during the last two months. A larger reduction is, however, expected by the end of the year, although from now on supplies of metal are to be released at the rate of 10 per cent. per month for the next ten months.

Official closing prices :—

Cash.—Thursday, £147 15s. to £148; Friday, £153 15s. to £154; Monday, £154 15s. to £155; Tuesday, £157 5s. to £157 10s.; Wednesday, £157 12s. 6d. to £157 15s.

Three Months.—Thursday, £149 to £149 5s.; Friday, £155 to £155 2s. 6d.; Monday, £156 5s. to £156 10s.; Tuesday, £158 15s. to £159; Wednesday, £159 5s. to £159 10s.

Spelter.—Increased business has been done with consumers here, and many inquiries have been attracted by the firmer tone of the market. Slightly improved conditions in the galvanised-sheet and brass-ware markets offer a brighter future for the spelter market, as a large proportion of the foundries in these trades allowed their stocks to run very low during the slack summer period.

Daily fluctuations :—

Ordinary.—Thursday, £15; Friday, £15 7s. 6d.; Monday, £15 18s. 9d.; Tuesday, £16 5s.; Wednesday, £16 10s.

Lead.—Here again an appreciable amount of forward buying by consumers has been witnessed, owing to an improved demand for finished products. Recent arrivals of metal have been on the small side, but the present demand is easily met from the stocks held in this country.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £12 17s. 6d.; Friday, £13 7s. 6d.; Monday, £13 16s. 3d.; Tuesday, £14; Wednesday, £14 7s. 6d.

International Institute of Steel Construction.

An international Institute of Steel Construction has been organised and it is proposed that executive officers under the direction of E. A. van Genderen Stort, Consulting Engineer, shall be established at The Hague. This step was taken at a conference held last May in Paris, at which it will be remembered ways and means were discussed for extending the use of steel. In a previous issue was given a short list of the representative bodies of the various countries attending that conference.

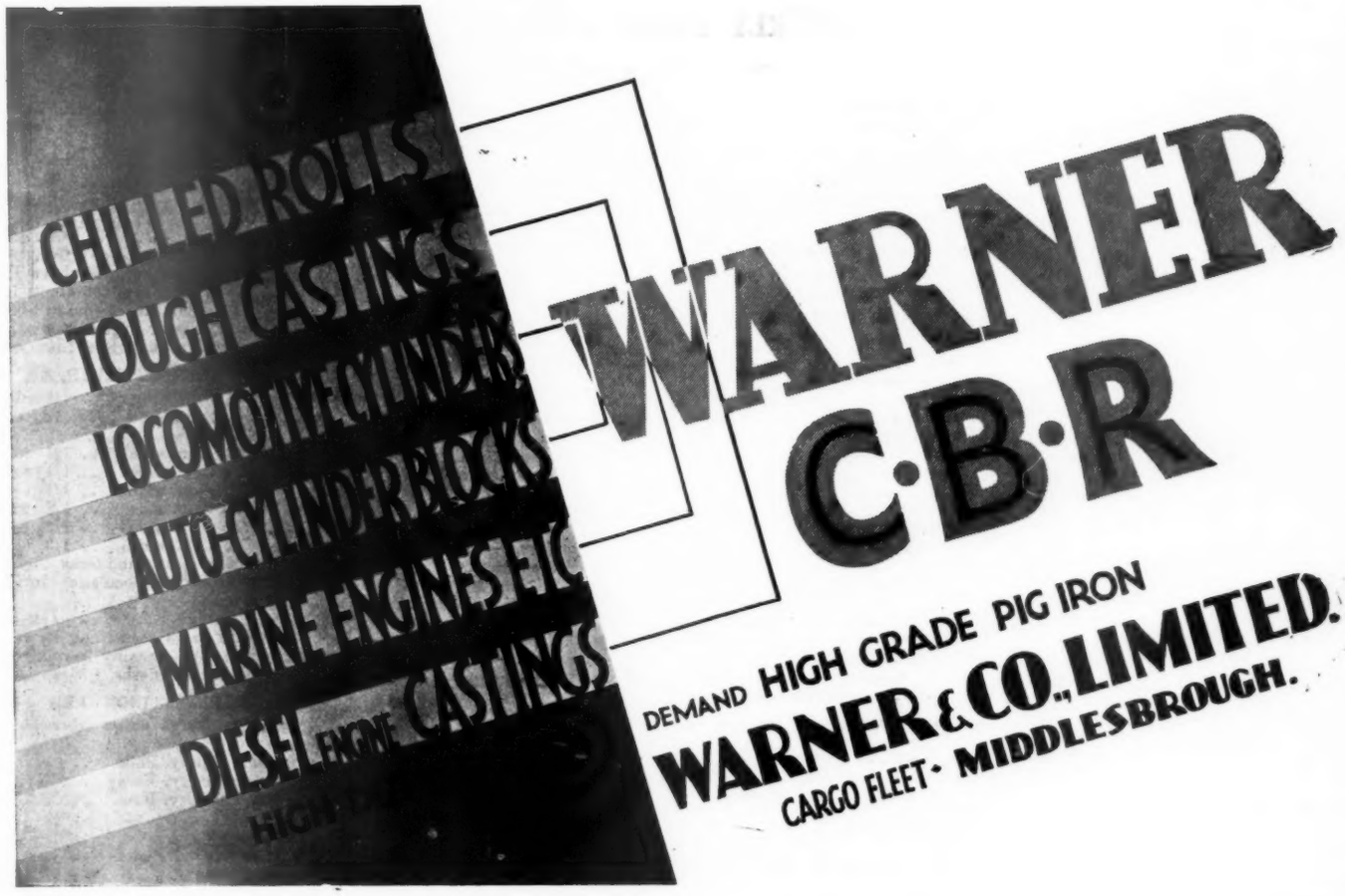
A more complete list, reproduced herewith, is now given in a report just issued:—Ossature Métallique in Belgium, Beratungsstelle für Stahlverwendung in Germany, British Steelwork Association in Great Britain, Office Technique pour l'Utilisation de l'Acier in France, Vereeniging van Metaalindustrieelen in Holland, A.-G. für Förderung der Ungarischen Mehrproduction in Hungary, Associazione Nationale Fascista fra gli Industriali Metallurgici Italiani in Italy, Syndykat Polskich Hut Zelaznych in Poland, Verkaufsstelle vereinigter Tschechoslovakischer Eisenwerke A.-G. in Czecho-Slovakia and Verband Schweiz. Brückenbau und Eisenhochbau-Fabriken in Switzerland. Besides these, similar offices are likely to be founded in Sweden and Spain.

A documentation department has been set up for collecting, classifying and publishing literature and other data relating to the use of steel.

The department will correspond in three languages, viz., French, English and German.

Hard-Metal Carbides.—Dr. Colin G. Fink, head, division of electrochemistry, Columbia University, New York, and G. A. Meyerson conducted an investigation to find a way of reducing the brittleness, without sacrifice in hardness, of the cobalt-tungsten carbide and similar alloys now so widely used for the bearings of drawing dies and as cutting edges for lathe and other tools. Their experiments indicate that the proper selection of the binding or cementing material for the carbide is of prime importance, and that the substitution of a hard, tough alloy, such as cobalt-tungsten, cobalt-carbon-tungsten, or cobalt-molybdenum, in place of cobalt alone, results in a carbide alloy which is not only a tougher but even a harder product. It was found that an alloy composed of 94.75 per cent. of tungsten carbide (WC) and 5.25 per cent. of cobalt in which the cementing material was an alloy of cobalt, tungsten and carbon, resulted in a finished alloy which was very tough and of a hardness equal to 87.3 Rockwell.—"The Iron Age."

XUM



CAST IRON FLANGED PIPES

2 in.—12 in. & CONNECTIONS. to 24 in. dia.

WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.

JAMES & RONALD RITCHIE, LTD.,

Telephone: 3852 (2 Lines). **MIDDLESBROUGH.** Telegrams: "Ritchie, Middlesbrough."

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	37 13 9
Three months	37 13 9
Electrolytic	40 0 0
Tough	38 15 0
Best selected	39 5 0
Sheets	68 0 0
India	47 0 0
Wire bars	40 15 0
Do., Oct.	40 15 0
Do., Nov.	40 15 0
Ingot bars	39 15 0
H.C. wire rods	43 0 0
Off. av. cash, August	31 9 1 2/5
Do., 3 mths., August	31 6 8 3/5
Do., Sttlmnt., August	31 8 11 5/11
Do., Electro, August	35 2 4 7/11
Do., B.S., August	33 15 3 1/5
Do., wire bars, August	35 9 1 7/11
Solid drawn tubes	10d.
Brazed tubes	10d.
Wire	6½d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7⅞d.
Wire	7⅛d.
Rolled metal	7½d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN.

	£ s. d.
Standard cash	157 12 6
Three months	159 5 0
English	159 10 0
Bars	161 0 0
Straits	162 0 0
Australian	160 10 0
Eastern	162 5 0
Banca	162 5 0
Off. av. cash, August	142 2 4 7/11
Do., 3 mths., August	143 12 3 1/11
Do., Sttlmt., August	142 1 1 7/11

SPELTER.

	£ s. d.
Ordinary	16 10 0
Remelted	15 5 0
Hard	12 10 0
Electro 99.9	18 12 6
English	17 5 0
India	15 5 0
Zinc dust	21 0 0
Zinc ashes	2 5 0
Off. aver., August	13 14 4½
Aver. spot, August	13 11 10½

LEAD.

	£ s. d.
Soft foreign ppt.	14 7 6
Empire	14 10 0
English	16 5 0
Off. average, August	11 9 4½
Average spot, August	11 6 11 1/2

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	23 0 0
Do., V.M. ex-whse.	22 10 0
Rods	27 0 0
Boiler plates	23 0 0
Battery plates	—

ANTIMONY.

	£ s. d.
English	35 0 0 to 42 10 0
Chinese	24 10 0
Crude	16 0 0

QUICKSILVER.

	£ s. d.
Quicksilver	9 5 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 0 0
45/50%	£13 15 0
75%	£19 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	10½d. lb.
Ferro-phosphorus, 20/25%	£20 0 0
Ferro-tungsten—	
80/85%	1/9 lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car.	£34 5 0
4/6% car.	£25 15 0
6/8% car.	£24 10 0
8/10% car.	£22 5 0
Ferro-chrome—	
Max. 2% car.	£37 5 0
Max. 1% car.	£44 10 0
Max. 0·70% car.	£45 17 6
70%, carbon-free	1/- lb.
Nickel—80/99.5%	£240 to £245
"F" nickel shot	£216 0 0
Ferro-cobalt	7/9 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/4½ lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.	£ s. d.
South Wales—		
Heavy steel	1 18 0	to 1 19 0
Bundled steel and shrngs.	1 15 0	to 1 18 0
Mixed iron and steel	1 15 0	to 1 16 0
Heavy cast iron	2 2 6	to 2 3 6
Good machinery	2 5 0	to 2 7 6
Cleveland—		
Heavy steel	1 15 0	
Steel turnings	1 8 0	
Cast-iron borings	1 2 6	
Heavy forge	2 10 0	
W.I. piling scrap	2 2 6	
Cast-iron scrap	1 15 0	to 1 16 0
Midlands—		
Light cast-iron scrap	1 15 0	
Heavy wrought iron	2 2 6	
Steel turnings, f.o.r.	0 19 0	
Scotland—		
Heavy steel	1 12 6	
Ordinary cast iron	1 19 0	
Engineers' turnings	1 7 6	
Cast-iron borings	1 10 0	
Wrought-iron piling	2 0 0	
Heavy machinery	2 3 6	

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	27 0 0
Brass	17 0 0
Lead (less usual draft)	11 0 0
Tea lead	9 10 0
Zinc	8 0 0
New aluminium cuttings	74 0 0
Brasiery copper	24 0 0
Gunmetal	18 0 0
Hollow pewter	85 0 0
Shaped black pewter	65 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	60/6
Hematite M/Nos.	60/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	71/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs No. 4 forge*	61/-
,, No. 3 fdry.*	66/-
Shrops basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	57/6
,, fdry. No. 3*	62/6
,, fdry. No. 1*	65/6
Derbyshire forge*	61/-
,, fdry. No. 3*	66/-
,, fdry. No. 1*	69/-
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
,, No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
,, fdry. No. 3	63/6
Lincs forge	—
,, fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
,, fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalsell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	84/6
Clyde, No. 3	84/6
Monkland, No. 3	84/6
Summerlee, No. 3	84/6
Eglinton, No. 3	84/6
Gartsherrie, No. 3	84/6
Shotts, No. 3	84/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	9 5 0 to	9 15 0
Nut and bolt iron	7 15 0 to	8 10 0
Hoops	10 10 0 to	12 0 0
Marked bars (Staffs) f.o.t.		12 0 0
Gas strip	10 10 0 to	12 0 0
Bolts and nuts, ¾ in. × 4 in.		12 0 0
Steel—		
Plates, ship, etc.	8 15 0 to	8 17 6
Boiler plts.	8 7 6 to	9 5 0
Chequer plts.		10 7 6
Angles		8 7 6
Tees		9 7 6
Joists		8 15 0
Rounds and squares, 3 in. to 5½ in.		9 7 6
Rounds under 3 in. to ¼ in. (Untested)	8 12 6	& up.
Flats—8 in. wide and over		8 12 6
,, under 8 in. and over 5 in.		8 17 6
Rails, heavy	8 5 0 to	8 10 0
Fishplates		12 0 0
Hoops (Staffs)		9 10 0
Black sheets, 24g.	8 0 0 to	8 10 0
Galv. cor. shts.	9 0 0 to	9 10 0
Galv. flat shts.	9 10 0 to	10 10 0
Galv. fencing wire, 8g. plain		12 10 0
Billets, soft	4 17 6 to	5 7 6
Billets, hard		6 12 6
Sheet bars	4 15 0 to	5 5 0
Tin bars		4 15 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	11⅝d.
Rods	10½d.
Tubes	16d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated

	Dols.
No. 2 foundry, Phila.	13.84
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.30
Bessemer	16.80
Malleable	16.30
Grey forge	16.30
Ferro-mang. 80%, seaboard	68.00
O.-h. rails, h'y, at mill	43.00
Billets	26.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.55
Sheets, black, No. 24	2.10
Sheets, galv., No. 24	2.75
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 22/6
,, furnace	16/- to 16/6
Durham and Northumberland—	
,, foundry	21/- to 25/-
,, furnace	12/-
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	15/- to 15/6
,,	28×20 ,,	30/- to 31/-
,,	20×10 ,,	22/- to 22/3
,,	18¾×14 ,,	15/6 to 15/9
C.W.	20×14 ,,	12/9 to 13/3
,,	28×20 ,,	—
,,	20×10 ,,	—
,,	18¾×14 ,,	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars-hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, at'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Sept.	1 ..	35	5	0	dec. 10/-
,,	2 ..	35	13	9	inc. 8/9
,,	5 ..	37	7	6	,, 33/9
,,	6 ..	37	17	6	,, 10/-
,,	7 ..	37	13	9	dec. 3/9

Electrolytic Copper.

		£	s.	d.	
Sept.	1 ..	37	10	0	No change
,,	2 ..	38	0	0	inc. 10/-
,,	5 ..	39	0	0	,, 20/-
,,	6 ..	40	0	0	,, 20/-
,,	7 ..	40	0	0	No change

Standard Tin (cash).

		£	s.	d.	
Sept.	1 ..	147	15	0	dec. 5/-
,,	2 ..	153	15	0	inc. 120/-
,,	5 ..	154	15	0	,, 20/-
,,	6 ..	157	5	0	,, 50/-
,,	7 ..	157	12	6	,, 7/6

Tin (English ingots).

		£	s.	d.	
Sept.	1 ..	149	10	0	dec. 5/-
,,	2 ..	155	10	0	inc. 120/-
,,	5 ..	156	15	0	,, 25/-
,,	6 ..	159	0	0	,, 45/-
,,	7 ..	159	10	0	,, 10/-

Spelter (ordinary).

		£	s.	d.	
Sept.	1 ..	15	0	0	dec. 1/3
,,	2 ..	15	7	6	inc. 7/6
,,	5 ..	15	18	9	,, 11/3
,,	6 ..	16	5	0	,, 6/3
,,	7 ..	16	10	0	,, 5/-

Spelter (Electro, 99.9 per cent.).

		£	s.	d.	
Sept.	1 ..	17	7	6	No change
,,	2 ..	17	15	0	inc. 7/6
,,	5 ..	18	7	6	,, 12/6
,,	6 ..	18	12	6	,, 5/-
,,	7 ..	18	17	6	,, 5/-

Zinc Sheets (English).

		£	s.	d.	
Sept.	1 ..	22	10	0	No change
,,	2 ..	22	10	0	,, ,,
,,	5 ..	22	10	0	,, ,,
,,	6 ..	23	0	0	inc. 10/-
,,	7 ..	23	0	0	No change

Lead (English).

		£	s.	d.	
Sept.	1 ..	15	0	0	dec. 5/-
,,	2 ..	15	10	0	inc. 10/-
,,	5 ..	15	15	0	,, 5/-
,,	6 ..	16	0	0	,, 5/-
,,	7 ..	16	5	0	,, 5/-

AVERAGE MONTHLY PRICES OF UNMARKED BARS (SOUTH STAFFS).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1898	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 5 0	6 5 0	6 5 0	6 10 0	6 10 0	6 2 11
1899	6 10 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 10 0	7 10 0	8 10 0	9 0 0	9 0 0	9 10 0	7 12 11
1900	10 0 0	10 10 0	10 10 0	10 10 0	10 15 0	10 15 0	10 5 0	10 5 0	10 5 0	9 10 0	8 15 0	8 15 0	10 1 3
1901	8 0 0	7 10 0	7 5 0	7 0 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 15 0	6 17 11
1902	7 0 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 13 4
1903	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 7 0	6 5 0	6 9 4
1904	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 2 11
1905	6 5 0	6 5 0	6 0 0	5 17 6	5 15 0	5 15 0	5 15 0	5 15 0	6 0 0	6 5 0	6 15 0	6 15 0	6 1 10½
1906	7 0 0	7 5 0	7 5 0	7 5 0	6 17 6	6 15 0	6 12 6	6 10 0	6 10 0	6 12 6	6 16 3	7 3 9	6 17 8½
1907	7 3 9	7 5 0	7 5 0	7 5 0	7 5 0	7 7 6	7 5 0	7 7 6	7 7 6	7 7 6	7 7 6	7 5 0	7 5 11
1908	7 2 6	7 0 0	7 0 0	7 0 0	6 15 0	6 7 6	6 5 0	6 2 6	6 2 6	6 2 6	6 2 6	6 0 0	6 10 0
1909	6 0 0	6 0 0	5 17 6	6 0 0	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 2 6	6 2 6	5 17 6	5 19 9½
1910	6 2 6	6 3 4½	6 7 6	6 7 6	6 7 6	6 7 6	6 6 6	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 7
1911	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0
1912	6 18 9	7 1 10	7 2 6	7 8 9	7 18 0	8 0 7	8 2 6	8 3 6	8 5 0	8 6 3	8 7 6	8 8 9	7 17 0
1913	8 11 6	8 10 7½	8 10 0	8 8 1½	8 2 0	8 0 0	7 17 6	7 11 6	7 8 9	7 5 6	6 18 1½	6 17 6	7 16 9
1914	6 17 6	6 15 7½	6 12 6	6 10 0	6 10 0	6 10 0	6 10 0	7 11 10½	8 0 0	7 12 6	7 5 7½	7 6 3	7 1 0
1915	7 11 6	8 5 11	8 8 9	9 6 0	10 3 2	10 19 2	11 12 6	11 13 1½	11 13 9	11 14 3	12 1 10½	13 0 9	10 8 0
1916	13 7 6	13 10 8	13 12 9½	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 6	13 15 0	13 15 0	13 15 0	13 3 9½
1917	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0
1918	13 15 0	13 17 3	13 17 6	13 17 6	13 17 6	13 17 6	13 17 6	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 4 5½
1919	15 10 0	16 5 0	17 15 0	17 15 0	20 15 0	21 0 0	21 0 0	22 0 0	22 0 0	22 0 0	22 7 6	22 12 6	20 1 8
1920	24 7 6	24 10 0	25 10 0	27 10 0	29 5 0	31 0 0	31 10 0	31 10 0	31 10 0	31 10 0	31 10 0	29 7 6	29 1 8
1921	26 17 3	25 0 0	23 0 0	21 0 0	19 0 0	18 5 0	16 0 0	16 0 0	15 14 0	14 0 0	13 6 8	13 0 0	19 4 5
1922	13 0 0	12 3 9	11 14 0	11 11 10½	11 5 0	11 3 6	11 2 6	11 5 0	10 17 2½	10 16 3	10 13 0	10 12 6	11 7 9½
1923	10 16 10½	11 3 1½	12 2 6	12 8 9	12 11 6	12 1 3	11 15 11½	11 15 0	11 15 0	11 15 0	12 13 6	12 8 3	11 18 10½
1924	12 9 6	12 10 0	12 10 0	12 15 7½	12 17 6	12 17 6	12 17 6	12 17 6	12 17 6	12 14 0	12 12 6	12 12 6	12 14 5½
1925	12 12 6	12 12 6	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 4 6	11 18 6	11 19 9	11 13 0	12 8 2½
1926	11 7 9½	11 5 0	11 5 0	11 5 0	11 3 9	11 3 9	11 5 0	12 0 0	13 0 0	*	15 7 6	12 19 0	12 0 2
1927	12 6 3	12 2 6	11 14 0	11 0 0	10 18 9	10 12 6	10 12 6	10 5 0	9 16 0	9 15 0	9 13 9	9 12 9	10 14 2
1928	9 12 6	9 12 6	9 11 0	9 10 0	9 8 4	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 3 6	9 1 3	9 7 0
1929	9 0 0	9 2 6	9 5 7½	9 9 4½	9 10 0	9 17 6	10 2 6	10 2 6	10 2 6	10 0 6	10 3 9	10 5 7	9 15 2½
1930	10 7 6	10 7 6	10 7 6	10 6 10½	10 6 3	10 5 0	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 4 7½
1931	10 2 6	10 0 0	10 0 0	9 18 1½	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 16 10½	9 18 0½
1932	9 15 0	9 15 0	9 15 0	9 15 0	9 13 9	9 11 3	9 10 0	9 10 0	—	—	—	—	—

* No quotation available owing to strike.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

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